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The Engineer.

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VOL. CXLVI.—No. 3802] LONDON: FRIDAY EVENING, NOVEMBER 23, 1928 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

STEEL GIRDER BRIDGES FOR SALE.

The Director of Army CONTRACTS has a number of STEEL GIRDER BRIDGES FOR DISPOSAL of the following types, which are dismantled and packed :—
Hopkins, 120ft. span.
Hopkins, 75ft. span.
Mark II., 60ft. span.
Mark II., 30ft. span.
Mark III., 21ft. 6in. span.
Pont Levis, 22ft. span.
Further information may be obtained from the DIRECTOR OF ARMY CONTRACTS, D.C. 4, Caxton House West, Tothill-street, London, S.W. 1. 278

The Director - General, India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
SCHEDULE 1.—44 LOCOMOTIVES, XE Type.
SCHEDULE 2.—163 TONS SPRING STEEL.
Tenders due on the 11th December, 1928, for No. 1, and on the 17th December, 1928, for No. 2.
Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each Schedule. 301

Air Ministry. DIRECTORATE OF TECHNICAL DEVELOPMENT.
JUNIOR TECHNICAL OFFICERS are REQUIRED at the Royal Aircraft Establishment for :—
(1) VACANCY A. 304.—Tests and Experimental Work on Strength of Materials and Aircraft Components.
(2) VACANCY A. 305.—Work in the Engine Experimental Department.
Candidates should have had technical training to the standard of Honours B.Sc. Degree and works experience. Ability to write reports of experimental work is necessary.
Candidates must be medically fit for flying and willing to fly as observer. Other things being equal, preference will be given to ex-Service men.
Salary £175-15-235 plus C.S.B. per annum, giving present total starting remuneration of £259 9s. per annum.
For form of application write, giving the appropriate vacancy number, to the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants. 280

Assistant Engineers (2) REQUIRED by the RAILWAY DEPARTMENT of the FEDERATED MALAY STATES GOVERNMENT for four years' service, with possible extension. Salary 400 dollars, rising to 475 dollars a month by annual increments of 25 dollars a month, and thereafter, in the event of the officer being retained, rising to 800 dollars a month, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. If at the end of four years' service the officer's services have been continuously satisfactory and he does not remain in the service, he will be paid a bonus of 2850 dollars. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but the purchasing power of the dollar in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax is at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 30, preferably unmarried, must have received a good theoretical training, preferably at a University or a College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree, or obtained such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case, or completed their articles with a Civil Engineer of good standing and have passed the examination for Associate Membership of the Institution of Civil Engineers. Should have had at least one year's practical experience of Railway Maintenance on a British railway.—Apply at once by letter, giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, mentioning this paper and quoting clearly at head of application M/1133. 272

The Government of India REQUIRE an ASSISTANT FOREMAN for TOOL-ROOM, GUN CARRIAGE FACTORY, JUBBULPORE (APPOINTMENT 114). QUALIFICATIONS.—(1) Good general and technical education; (2) full apprenticeship in large engineering works in Great Britain, and at least three years' subsequent experience in up-to-date tool, jig and die design and manufacture; (3) experience in design and manufacture of drop stamping dies and knowledge of latest practice connected with hardening and heat treatment of tools in general is essential; (4) should preferably have had some experience in tool drawing-office and be thoroughly conversant in use of shop manufacturing drawings; (5) must be capable organiser and tactful in dealing with labour; (6) age not more than 30 years. Preference given to candidate with experience of Army gun carriage equipments. Salary Rs. 450-15-510 per calendar month, with prospects of further increases. TERMS.—Agreement for five years in first instance. Free second-class passage to India and return passage on satisfactory termination of services. Free quarters. Medical examination.—Further particulars and forms of application may be obtained (on request by postcard, quoting number of appointment) from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 15th December, 1928. 286

Armourers' and Braziers' COMPANY.

LECTURES IN METALLURGY.
The Company have arranged for the following Lectures to be delivered :—
At the Sir John Cass Technical Institute, 31, Jewry-street, Aldgate, E.C., at 8.15 p.m. on 28th November, 5th and 12th December, 1928, by
S. W. SMITH, Esq., D.Sc., A.R.S.M.,
on
"CERTAIN ASPECTS OF THE SOLIDIFICATION OF METALS AND ALLOYS."

At the Borough Polytechnic Institute, St. George's-circus, S.E. 1, at 5.30 p.m. on 29th November, 7th and 14th December, 1928, by
C. A. EDWARDS, Esq., D.Sc.,
on
"THE MANUFACTURE OF TIN-PLATE."
Admission free, without ticket. 198

The Engineer

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PUBLIC NOTICES

Civil Service Commission.
FORTHCOMING EXAMINATION: MECHANICAL ENGINEERING DRAUGHTSMEN in War Department Establishments (open to ex-Service men over 24 years of age).
Regulations and particulars are obtainable from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, together with the form on which application must be made. The latest date for the receipt of application forms is 20th December. 279

University of Durham.
ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE.
LECTURESHIP IN CIVIL ENGINEERING.
The Council of Armstrong College invites APPLICATIONS for a LECTURESHIP in CIVIL ENGINEERING. Salary £350 to £400, according to qualifications. Candidates must have had practical experience and have a good knowledge of surveying. Duties to commence on 8th January, 1929. Ten copies of applications and of not more than three testimonials should be lodged, not later than Tuesday, 27th November, 1928, with the undersigned, from whom further particulars may be obtained.
J. Y. T. GREIG, Registrar.
Armstrong College. 184

The University of Sheffield.
DEPARTMENT OF MECHANICAL ENGINEERING.
PROFESSOR: F. C. LEA, D.Sc., M. Inst. C.E., M.I. Mech. E.
The Council is about to APPOINT an ASSISTANT LECTURER and DEMONSTRATOR in MECHANICAL ENGINEERING.
Candidates should have an Honours Degree in Engineering and preference will be given to an applicant who has had practical experience in Heat Engines and Electrical Engineering.
Salary £300 per annum.
Applications should reach the undersigned not later than December 7th, from whom further particulars can be obtained.
W. M. GIBBONS, Registrar.
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PUBLIC NOTICES

The Committee of Management of the BENEVOLENT FUND of the INSTITUTION of CIVIL ENGINEERS hereby CONVENE an EXTRAORDINARY GENERAL MEETING of the Contributors to the Fund, to be held at the Institution, Great George-street, Westminster, S.W. 1, at 4.30 p.m. on FRIDAY, the 30th NOVEMBER, for the purpose of appointing a Trustee of the Capital in the place of the late Sir Alexander Blackie William Kennedy, LL.D., D.Eng., F.R.S. 282

Bengal-Nagpur Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for :—
10 PLATE GIRDER BRIDGES (80ft. span).
Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Monday, 19th November, 1928.
A fee of 20s. will be charged for each copy of the specification, which is NOT returnable.
Tenders must be submitted not later than Noon on Thursday, 29th November, 1928.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.
By Order of the Board,
R. C. VOLKERS, Secretary.
249

Borough of Bedford.
WATERWORKS.
CONTRACT NO. 1.
TO CONTRACTORS.
The Town Council of Bedford is prepared to receive TENDERS for the CONSTRUCTION of THREE STORAGE RESERVOIRS and TWO OPEN SAND FILTERS with the necessary PIPE CONNECTIONS, to be constructed in accordance with the plans and specification prepared by the Engineers, Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.
Contractors desirous of tendering may obtain copies of the general conditions, specification, and bill of quantities and form of Tender from the Engineers upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender, and the drawings may be inspected either at the offices of the Engineers or at the offices of the Borough Engineer, Newnham House, Bedford.
Sealed Tenders, endorsed "Waterworks, Contract No. 1," must be delivered to the undersigned at the Town Hall, Bedford, before Twelve Noon on Monday, the 10th day of December, 1928.
The Council does not bind itself to accept the lowest or any Tender.
By Order,
(Signed) HENRY DARLOW, Town Clerk.
Town Hall, Bedford. 248

PUBLIC NOTICES

Clyde Navigation Trust.
TO CONTRACTORS.
The Trustees of the Clyde Navigation invite TENDERS for the CONSTRUCTION of a SINGLE-STOREY GOODS SHED on EAST QUAY, DOCK No. 1, SHIELDHALL, GLASGOW, 1080ft. in length by 100ft. in width. The work embraces about 1100 tons of Steel for Columns, Girders, &c., and includes Timber Piled Foundations, Concrete Work and Brickwork.
Drawings may be seen and specification, schedule of quantities, and form of Tender obtained on application to Mr. A. M. Fulton, Chief Assistant Engineer to the Trustees, at his office here, on a deposit of Three Guineas, which will be refunded on receipt of a bona fide Tender.
Sealed Tenders, marked "Tender for Shed on East Quay, Dock No. 1, Shieldhall," to be lodged with the undersigned not later than Monday, 10th December, 1928.
The Trustees may not accept the lowest or any Tender.
JAS. MACFARLANE, General Manager.
16, Robertson-street, Glasgow, C. 2,
21st November, 1928. 284

County Borough of Halifax.
ELECTRICITY DEPARTMENT.
BOILER-HOUSE PLANT.
The Halifax Corporation are prepared to receive TENDERS for the SUPPLY and ERECTION of TWO WATER-TUBE BOILERS, together with SUPERHEATERS, MECHANICAL STOKERS, ECONOMISERS, AIR HEATERS, FEED PUMPS, and ONE STEEL BUILDING for housing of same.
Specification and form of Tender may be obtained on application to the Engineer and Manager, Electricity Offices, Town Hall-street East, Halifax, upon payment of a deposit of £2, which will be returned only after a bona fide Tender has been received.
Sealed Tenders, endorsed "Tender for Boiler-house Plant," must be delivered to the undersigned not later than Friday, December 7th, 1928.
The Council do not bind themselves to accept the lowest or any Tender.
PERCY SAUNDERS, Town Clerk.
Town Hall, Halifax,
13th November, 1928. 202

County Borough of Halifax.
ELECTRICITY DEPARTMENT.
TURBO-GENERATOR.
The Halifax Corporation are prepared to receive TENDERS for the SUPPLY and ERECTION of ONE 6500-kW M.C.E. GENERATOR and AUXILIARIES at the Foundry-street Generating Station, Halifax.
Specification and form of Tender may be obtained on application to the Engineer and Manager, Electricity Offices, Town Hall-street East, Halifax, upon payment of a deposit of £2, which will be returned only after a bona fide Tender has been received.
Sealed Tenders, endorsed "Generating Plant," must be delivered to the undersigned not later than Friday, December 7th, 1928.
The Council do not bind themselves to accept the lowest or any Tender.
PERCY SAUNDERS, Town Clerk.
Town Hall, Halifax,
13th November, 1928. 203

Metropolitan Water Board.
TENDERS FOR THE SUPPLY OF TWO CENTRIFUGAL PUMPS AT THE KEMPTON PARK PUMPING STATION, HANWORTH-ROAD, SUNBURY COMMON, MIDDLESEX.
The Metropolitan Water Board invite TENDERS for the SUPPLY of TWO CENTRIFUGAL PUMPS, one electrically driven and one water driven, capacity of each set one million gallons per 24 hours, 60ft. head, at their Kempton Park Pumping Station, Hanworth-road, Sunbury Common, Middlesex.
Forms of Tender, conditions of contract, specification and drawings may be inspected without payment of a fee at the Offices of the Board, Chief Engineer's Department (Room 173), on and after Monday, 26th November, 1928.
Contractors desirous of tendering may obtain the necessary documents from the Chief Engineer on production of an official receipt for the sum of One Guinea, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.
Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Pumps, Kempton Park," must be delivered at the Offices of the Board (Room 122) not later than 11 a.m. on Monday, 31st December, 1928.
The Board do not bind themselves to accept the lowest or any Tender.
G. F. STRINGER, Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue, E.C. 1,
19th November, 1928. 270

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PUBLIC NOTICES

Limerick Harbour Commissioners.

TO CRANE ENGINEERS.

The Limerick Harbour Commissioners are prepared to receive TENDERS for the SUPPLY of a 5-TON HAND PORTABLE CRANE.

Copies of the outline specification may be obtained on application to the Harbour Engineer, Engineer's Office, Docks, Limerick.

Tenders must be addressed to the Chairman, Limerick Harbour Commissioners, Harbour Office, O'Connell-street, Limerick, and must be delivered not later than Twelve o'clock Noon on Saturday, 15th December prox.

The lowest or any other Tender will not necessarily be accepted.

JOHN F. POWER, Secretary.

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South Indian Railway Company,

LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

SPARE PARTS FOR LOCOMOTIVE ENGINES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Spare Parts for Locomotive Engines," with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 14th December, 1928.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of the specification.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD, Managing Director.

91, Petty France, Westminster, S.W. 1.
21st November, 1928. 302

The Madras and Southern Mahratta Railway Company, Limited, invite TENDERS for :—

12,500 LINEAL YARDS SAIL CANVAS.

Tenders are due in on Tuesday, 11th December, 1928, by 2 p.m.

Tender form obtainable at address below ; fee One Guinea, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices :
25, Buckingham Palace-road, Westminster, S.W. 1. 271

Watford Union.

ENGINEERING WORK.

The Guardians of the Poor of the Watford Union invite TENDERS from competent firms for the following WORKS, in sections, at their Institution, 60, Vicarage-road, Watford :—

SECTION 1.—Heating and Hot Water Supply and Electric Lighting at the new Casual Block.

SECTION 2.—Heating and Hot Water Supply and Electric Lighting at the new Mental and Infirmary Block.

Firms may Tender for either or both Sections, in accordance with the general conditions, specifications and plans prepared by the Guardians' Consulting Engineer, Mr. W. M. Binny, A.M.I.C.E., M. Cons. E., 39, Carlton-road, Putney, S.W. 15.

Firms wishing to Tender should send their names in the first instance to the undersigned.

The Guardians do not bind themselves to accept the lowest or any Tender.

F. WILSON, Clerk to the Guardians.

Guardians' Office,
7, Church-street, Watford,
19th November, 1928. 261

Municipality of Singapore.

STRAITS SETTLEMENTS.
ELECTRICITY DEPARTMENT.
CHARGE ENGINEER.

The Municipal Commissioners of Singapore REQUIRE a CHARGE ENGINEER for service at their New Power Station, the appointment being on the permanent staff of their Electricity Department and being in the first instance upon a three years' agreement.

The capacity of the plant first installed was 12,000 kW, with an extension of 10,000 kW now in progress.

Candidates should have a thorough experience in extra high-tension, three-phase generation, steam turbines, water-tube boilers and mechanical stokers, and must have held a similar position for at least two years.

Strict medical examination required.

Salary 5100 dollars, 5400 dollars, and 5700 dollars per annum respectively for the three years of the agreement, and rising thereafter (if service be continued) in accordance with the Commissioners' Salary Scheme. The exchange value of the dollar is 2s. 4d. sterling, at which rate the salary for the first year would amount to £595. There is at present no income tax. Free partially furnished quarters are provided at a rental of 6 per cent. of salary.

Free passage will be provided with half salary during voyage out. Eight months' leave with full pay is normally granted after four years' service. Liberal Provident Fund.

Applications, stating whether married or single, and giving age and birthplace, with details of education, training and experience, and referring particularly to the qualifications mentioned above, and accompanied by copies (not originals) of testimonials, to be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 64, Victoria-street, London, S.W. 1, Agents to the Commissioners, not later than Monday, the 3rd December, 1928.

Further particulars, if desired, can be obtained from the Agents. 281

Surbiton Urban District Council.

ENGINEERING ASSISTANT.

The above Council REQUIRE the SERVICES of a competent ENGINEERING ASSISTANT to prepare, under the instructions of their Surveyor, drawings, specification, and quantities for additions to their Sewage Disposal Works and to act as Resident Engineer during the construction of such work.

The engagement is to be for a period of two years, subject to satisfactory service, at a salary at the rate of £400 per annum.

Previous experience in the designing of and the preparation of plans for sewage disposal works is essential.

Applications, giving age, professional qualifications and previous experience, and accompanied by copies of three recent testimonials, must be addressed Mr. Henry T. Mather, Surveyor to the Council, so as to reach him not later than Monday, the 3rd December, 1928.

C. EDGAR SHELLY, Clerk to the Council.

Council Offices,
Ewell-road, Surbiton.
November, 1928. 250

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED for India, ENGINEERING ASSISTANTS, age 24-26, unmarried. Headquarters in Calcutta. Applicants should have sound engineering training and drawing-office experience, preferably in Structural Steel Work. Public school type preferred.—Applications, with full particulars, should be addressed to Box 375, Leathwait and Simmons, 34, Throgmorton-street, London, E.C. 2. P5232 A

WANTED.—MANUFACTURERS of VACUUM PUMPS and COMPRESSORS REQUIRE a TECHNICAL REPRESENTATIVE with a good connection and accustomed to call on users of these machines.—Address applications, with full particulars of age, experience, and salary required, P5234, The Engineer Office. P5234 A

SITUATIONS OPEN (continued)

A LARGE POWER COMPANY REQUIRE the SERVICES of a first-class MECHANICAL ENGINEER, with experience of modern Central Station Plant, to Take Charge of their Repairs and Maintenance Department. Applicants, who should be under 40 years of age, must have had a good education and a sound technical and practical training. Salary according to ability and experience, but not less than £400 per annum.—Address, 295, The Engineer Office. 295 A

APPLICATIONS are INVITED for POSITIONS in the Personnel Dept. of a large Industrial Organisation comprising many branches of manufacture. Graduates and others who have had training and experience in one or more of the following will be considered :—Works production, industrial education, welfare, employment, application of industrial psychology and psychological methods of vocational selection. State age, salary required, and details of experience.—Address, P5223, The Engineer Office. P5223 A

ASSISTANT ENGINEER WANTED for the Office of a Consulting Engineer for India. Must be of college education and sound practical works experience, able to design, estimate and supervise General Mechanical and Electrical Work. Must be A.M.I.C.E. and also preferably A.M.I.E.E., age 25 to 35 and unmarried. Salary £750 per annum and first-class passage to India with travelling expenses.—Apply in the first place to Post Box 2240 Calcutta, with detailed particulars of experience and education. 296 A

CAPABLE MECHANICAL ENGINEER, with Drawing-office experience, REQUIRED as PRODUCTION MANAGER. Knowledge of Electric Battery Vehicles essential. When applying give full particulars as to training, with references, age, and salary required.—Address, P5228, The Engineer Office. P5228 A

CHEMICAL ENGINEER WANTED. Age About 30-35, with experience in responsible control of organic and synthetic process work, plant, and staff. The opening affords an exceptional opportunity for a gentleman already well placed in his profession, who would seek to fulfil the managership of a large and important works. Only one with public school education and University Degree need apply, and should give full details of career, qualifications, and salary required. Applications will be treated in strict confidence.—Address, P5219, The Engineer Office. P5219 A

ENGINEER REQUIRED for South India. Qualifications : first-class Structural and Mechanical Draughtsman with knowledge of estimating and designing and apprenticeship served with leading constructional firm. First agreement 5 years, passage and outfit allowance paid. Age not exceeding 24.—Reply, with full particulars, to Box 567, c/o Judd's, 47, Gresham-street, London, E.C. 2. 267 A

EXPERIENCED ENGINEER REQUIRED as Travelling Representative Consultant in Heat Transfer Apparatus. State age and full qualifications.—Address, P5224, The Engineer Office. P5224 A

EXPERIENCED RATE FIXER, Capable of Setting times on Internal Combustion Engine Fitting and Assembling. Only those with rate fixing experience need apply. State experience and salary required.—Address, 260, The Engineer Office. 260 A

GENERAL MANAGER REQUIRED for Small Engineering Works in South of England engaged in General and Boiler Repair Work, &c. Applicant required to assume responsibility for works management, estimates, &c. Opportunity to acquire directorship to right man. State experience and salary required.—Address, P5233, The Engineer Office. P5233 A

LARGE AMERICAN COMMERCIAL and INDUSTRIAL FIRM OFFERS OPENING to a young MARINE ENGINEER for North-East Coast, 25/35 years of age, good education and engineering experience, preferably with a knowledge of Diesel Engines. Position calls for an ambitious man prepared to apply intensive effort and long hours to the duties assigned. Applicants must submit full particulars, which will be treated in confidence.
Address, P5212, The Engineer Office. P5212 A

REQUIRED, FOUR First-class STRESS-MEN, with experience of Detail Stressing and Air Ministry requirements.—State age, experience and salary required to the BLACKBURN AEROPLANE and MOTOR CO., Ltd., Brough, E. Yorks. 175 A

REQUIRED, Qualified ENGINEER, with Full Experience of Erection of Gasworks and with Coke Oven Practice ; age not to exceed 40. Salary £400 per annum.—Address, with particulars of qualifications and experience, 257, The Engineer Office. 257 A

SEVERAL TEMPORARY ASSISTANTS REQUIRED by a Consulting Engineer in Glasgow ; must be trained Engineers, with experience in Steam and Heating Installations, and have good knowledge of values of different kinds of plant. Applicants must state experience and salary required.—Address, "STEAM," Wm. Porteous and Co., Advertising Agents, Glasgow. P5194 A

THOS. FIRTH and SONS, Ltd., have a VACANCY for an experienced practical PRODUCTION ENGINEER, who can immediately carry the responsibility for the Planning and Progress of Work in their Machine Shops, particularly in connection with their Heavy Machine Shops engaged on Marine and General Engineering Work. Practical experience with that class of work and planning is absolutely essential. Applicants should state age, fullest details of experience and training, education, and salary required. Good prospects for the right man. Applications will be treated confidentially. Copies of testimonials re practical and planning experience should be submitted.—Address to "M.," Secretary, Norfolk Works, Sheffield. 185 A

STOREKEEPER REQUIRED for a Large General Engineering Works in the Midlands. Must be thoroughly experienced in modern methods, good organiser and disciplinarian.—Address full particulars and salary required, 292, The Engineer Office. 292 A

WORKS MANAGER REQUIRED for Engineering Firm in Midlands employing a thousand men. Electrical experience preferred, but not essential. Applicants must be competent to organise a varied production, to fix delivery dates. All applicants will be treated strictly in confidence. Salary to commence £900.—Address, P5213, The Engineer Office. P5213 A

WORKS MANAGER WANTED for Large Non-ferrous Foundry. Applications treated confidentially.—Address, stating fully experience, qualifications, age, salary required, &c., 303, The Engineer Office. 303 A

WANTED AT ONCE, TWO Good GENERAL SENIOR DRAUGHTSMEN, preferably with modern Cement Works experience.—Address, 124, The Engineer Office, giving full details of experience and copies of references. 124 A

WANTED, CHIEF DRAUGHTSMAN for Modern Design of Steam and Electrical Winders, Haulages, &c.—Address, 240, The Engineer Office. 240 A

WANTED, First-class CARRIAGE and WAGON DRAUGHTSMEN, experienced men only.—Apply, giving full particulars of experience, salary required, &c., to the BIRMINGHAM RAILWAY CARRIAGE and WAGON CO., Ltd., Smethwick. 211 A

WANTED for London Office, TWO or THREE DETAILING DRAUGHTSMEN, accustomed to Detailing Steel-framed Buildings. State, age, experience and salary required.—Address, 201, The Engineer Office. 201 A

DRAUGHTSMAN (Engineer), Accustomed to Design and General Lay-out of Pumping Machinery and Auxiliary Plant, Estimating, &c.—Address, stating age, experience, and salary required, 9672, The Engineer Office. 9672 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN (JUNIOR), MECHANICAL, for London, with practical knowledge of design of Cutting and Punching Machinery, for paper.—Write in confidence, stating age, salary and experience, Box 50, Sells Advertising Offices, Fleet-street, E.C. 4. 265 A

DRAUGHTSMAN REQUIRED, Accustomed to Producing Scheme Drawings and Projects for Conveyors and Mechanical Handling Plants ; only men capable and used to working on their own initiative will be considered.—State age, wages and experience.—Address, 289, The Engineer Office. 289 A

DRAUGHTSMAN WANTED for North-East Coast. First-class man with experience in Steel Works and Blast-furnace Work.—Full particulars, age, experience, salary required to Box "H," Kidd's Advertising Agency, Middlesbrough. 252 A

DRAUGHTSMAN, with First-class Designing ability, REQUIRED ; one with American or continental experience of Machine Tool Design preferred. State full experience, salary, age.—Address, 277, The Engineer Office. 277 A

DRAUGHTSMAN, with First-class Experience of Steam Turbine design and detail work, for works in Midlands. State age, salary, experience, and when able to commence.—Address, 274, The Engineer Office. 274 A

EXPERIENCED MACHINE TOOL DRAUGHTSMAN.—Apply by letter, stating qualifications, to J. PARKINSON and SON, Shipley, Yorks. P5220 A

JIG and TOOL DRAUGHTSMAN REQUIRED for Commercial Motor Vehicle Manufacturers in the South of England.—Address, stating age, experience, and salary required, 293, The Engineer Office. 293 A

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THE PROPRIETOR of BRITISH PATENT No. 222,696, dated November 12th, 1923, relating to "Improvements in an Oil Can," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or OTHERWISE on reasonable terms for the purpose of EXPLOITING the above PATENT and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 182 H

THE PROPRIETORS of BRITISH PATENT No. 239,093, relating to "Machines for End-grinding Conical Rolls," are DESIROUS of ENTERING into ARRANGEMENTS with BRITISH MANUFACTURERS with a view to the SALE or COMMERCIAL EXPLOITATION of the INVENTION protected by the said patent.

Interested parties are invited to communicate with the undersigned for further particulars.

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THE PROPRIETOR of BRITISH PATENT No. 194,078, dated January 23, 1922, relating to "Apparatus for Making Drop-forged Steel Car Wheels," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 289 H

THE OWNER of BRITISH PATENT No. 245,741, relating to "Method of Rolling Metals and Apparatus therefor," is DESIROUS of ENTERING into NEGOTIATIONS for the GRANT of LICENCES thereunder on reasonable terms or for the SALE of the PATENT.—For particulars address, F. W. LE TALL, 2, Norfolk-street, Strand, London, W.C. 2. 266 H

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THE PROPRIETOR of BRITISH PATENT No. 227,086, dated January 5th, 1924, relating to "Improvements in Faucets or Valves," is DESIROUS of ENTERING INTO ARRANGEMENTS by way of a LICENCE or OTHERWISE on reasonable terms for the purpose of EXPLOITING the above PATENT and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 285 H

THE PROPRIETOR of BRITISH PATENT No. 227,465, dated January 10, 1925 (under International Convention, January 11, 1924), relating to "Improvements in Method of and Machine for Milling Threads," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—Inquiries to Mr. B. SINGER, Woolworth Bldg., New York City, N.Y., U.S.A. 290 H

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

The British Engineering Standards Association.

In our issue of October 26th, in the course of a report of the tenth annual general meeting of the British Engineering Standards Association, we briefly recorded that, with the full support of the leading technical institutions, the Association had lodged a petition with the Privy Council for a Royal Charter, and that a scheme of reorganisation had been under consideration during the past year and was gradually maturing. We now learn that the reorganisation proposed will cover the division of the Association into ten or twelve distinct industrial sections, such as public works, electrical, mechanical, motor car, aircraft, gas and oil. Each section, in addition to carrying out its own work, will nominate for election by ballot representatives on the governing Committee or Council. This Council will also include representatives nominated by the founder institutions, Government Departments, the Federation of British Industries, Chambers of Commerce, and other bodies. The elected members are to be in a majority. It is anticipated that the subdivisions of the Association's work among industrial sections will enable those interested in particular trades to make even greater use of the Association's work than they have done in the past. It is also expected that the increased recognition of the importance of standardisation and simplification on a national basis will secure the support of the Association by many branches of industry not previously identified with its activities. The Association, as the British Engineering Standards Committee, was established in 1901 for the purpose of simplifying and standardising steel sections. In 1918 it was incorporated as an Association by license of the Board of Trade.

Research on Cold Worked Materials.

At a recent dinner of the Ironmongers' Company of London, it was stated by the Master of the Company (Mr. Ernest A. Ebblewhite) that it had been decided to found an Ironmongers' Company Research Fellowship and two Ironmongers' Company Research Scholarships for the study of the cold working of steel and other metals. For this purpose a grant of £800 per annum over a period of seven years will be made to the Sheffield University. It is hoped that the plant for the drawing and rolling of steels, along with the apparatus for making a systematic study of the various metallurgical and engineering operations involved in the processes, will be provided by manufacturers through the Cutlers' Company of Hallamshire. The ex-Master Cutler, Mr. Percy Lee, has interested himself in the scheme referred to, and is largely responsible, we understand, for the original scheme, which was submitted to the Ironmongers' Company, and which has met with such a generous response. The uses of cold-worked materials, such as wire, strip, and sheet, are becoming more frequent every day, and aeroplane design in particular now calls for the very highest qualities in cold-worked materials. Individual firms have carried out their own programmes of research and some University work has also been done, but it is now felt that a point has been reached at which problems arise which cannot be well solved without some provision being made for systematic research by trained investigators. The scheme we have outlined enjoys the full support of the industry, and it is believed that this co-operation between the producers and the new research laboratory and its workers will be highly beneficial to the iron and steel trade.

Mail Services in the Western Highlands.

Particulars of the contract dated November 16th, 1928, between the Ministry of Transport and the Postmaster-General, representing the Government, and David MacBrayne (1928), Ltd., for the maintenance of transport services in the Western Highlands and the conveyance of mails are given in a recent White Paper, and on Tuesday evening last the Western Highlands and Islands Transport Services Bill was read the second time in the House of Commons and the contract approved. The new company, styled David MacBrayne (1928), Ltd., will undertake the services hitherto rendered by David MacBrayne, Ltd., and immediate capital will be made available by the Burns and Laird Lines, Ltd., of Glasgow, one of the subsidiary companies of Coast Lines, Ltd., while the London, Midland and Scottish Railway Company will participate in the new company as soon as the necessary legislation enabling it to do so has been passed. The contract with the Government will continue in force until October 31st, 1938, when it may be extended. It provides for reductions in freight charges and in fares to and from places in the Western Highlands and Islands, outside the Firth of Clyde, equivalent on the average to an aggregate reduction of 10 per cent. The remuneration of the company for the services to be undertaken will be at the rate of £50,000 per annum, when the capital employed in providing these services amounts to £250,000. Arrangements are to be made for the construction of four new vessels, within a period of two years. The first boat to be built will be one for the Stornoway services, with a speed of not less than 12 knots in moderately bad weather, and a length of about 175ft. The second vessel will be for the Outer Islands service, with a speed of about 11 knots under similar weather conditions and a length of about 150ft. The same speed and length have been chosen for the third vessel for the Inner Isles services, and the fourth vessel will be for such services as may later be determined, and may have such a speed and size as may be found suitable.

Electricity in Mines.

The report of H.M. Electrical Inspector of Mines for the year 1927, which has just been issued, shows that during the last five years the rate of increase in the horse-power of motors installed was approximately steady, viz., an average annual addition of 88,790 horse-power for all purposes. Above ground, however, the average annual addition was 50,733 horse-power, whilst the increase below ground was 38,057 horse-power. Nearly 80 per cent. of the total power is derived from alternating-current systems. During the year 1927 there were eleven fatal accidents attributable either directly or indirectly to the use of electricity, and involving the loss of sixteen lives and serious injury to eight other persons. All of these accidents occurred at collieries, and, with only one exception, all happened below ground. Seven accidents, one of which was a double fatality, were simple cases of electric shock. There was one ignition of firedamp, which resulted in three deaths and injury to two other persons; one outbreak of fire below ground, which resulted in three deaths and injury to five other persons, and two accidents of a mechanical nature, each causing the death of one man. This constitutes the most serious record to the debit of electricity since the year 1924. Of the seven accidents in which death was due to electric shock, five arose from the rashness or carelessness of the individual who lost his life, while two can be classified under the heading of misadventure. While it is not difficult in most of the accidents to find carelessness on the part of the workmen, a perusal of the accounts that are included in the report will, perhaps, suggest that the management appears to rely unduly upon the discretion or knowledge of the individual workman.

The R. 101.

On Tuesday last representatives of the technical Press were given an opportunity of inspecting, at the works of Boulton and Paul, Ltd., Norwich, some of the structural members of the giant airship No. 101, and of studying the methods of manufacture. The forming of special sections from high tensile steels and aluminium alloys, both on the drawbench and in the rolling mill, was demonstrated, and the working and control of the continuous heat-treatment process developed by Boulton and Paul was explained to the visitors. The processes of manufacture were followed through the shops from the raw material to the completed girder, and a demonstration of the special methods adopted for the prevention of corrosion was given. We may recall that Messrs. Boulton and Paul have been engaged since 1924 upon this work, which has involved a great deal of research, much of it on a large scale. At the end of that year they completed the first two experimental longitudinal girders, in the construction of which were incorporated new types of members, new materials, and new methods of jointing. These girders were of the type ultimately approved by the Air Ministry. An experimental section of the airship for the purpose of proving the methods of construction was then designed and built in close co-operation with the Royal Airship Works. Following upon the successful tests of this section, the contract for the complete hull, fins and rudders was placed with the firm. The construction of the airship at Cardington is now practically completed, and we understand has gone forward practically without a hitch. We expect to give in an early issue a technical article upon some of the notable developments referred to above.

Pulverised Fuel on the Stuartstar.

As announced in a Journal note of August 31st last, the Blue Star cargo liner "Stuartstar" made her second trip out to South America with part of her boiler installation equipped with pulverised fuel burners of the Clarke, Chapman-Woodeson type. The first trip was made in July, after which it was decided to equip the port double-ended boiler, in addition to the forward single-ended boiler, with powdered fuel burners. The first installation was completed in eight days, and the vessel proceeded to Buenos Aires without a stop. During the twenty days of her passage the pulverisers were only stopped for two hours, during which voluntary stop an experimental adjustment to the pulveriser was made. On Friday last, November 16th, the Blue Star Line invited the members of the Society of Consulting Marine Engineers and Ship Surveyors to inspect the installation which was demonstrated in operation. The same evening Mr. W. E. Woodeson, B.Sc., gave a paper to the Society, in which he dealt with pulverised fuel and its application to ships' boilers, and gave some particulars of the "Stuartstar" installation. The equipment for the port double-ended boiler, with its ring main supplying powdered fuel and primary air is the first of its kind to be adopted, and both during the demonstration trial and on the trip round to the Tyne, the plant worked remarkably well, and good distribution to the six furnaces was maintained We understand that the coal used for pulverisation costs about 9s. 2d. per ton, and is thus about 30 per cent. cheaper than the usual coal for hand firing.

Thirty Years of Motor Car Design.

On Sunday last, November 18th, the Royal Automobile Club, in conjunction with certain newpapers, arranged a demonstration run from London to Brighton, in which only motor cars of twenty-five years of age or older were allowed to participate. The run was also commemorative of that made thirty-two years ago over almost the same course, to celebrate the passing of the Act of Parliament which relieved motorists of the necessity of being preceded by a man with a red flag when driving on the road. Incidentally the demonstration of these early cars in acutal operation enabled those who saw them to assess the great advances in engine, chassis, and body design which have taken place within the last quarter century. There was a total entry of forty-four cars, and they ranged from an 1891 Panhard to a 1903 Riley, and included many good examples of both early British and continental construction. Noteworthy was the thirty-three year old Thornycroft steam wagon, which was used by the late Sir John I. Thornycroft on his estate at Bembridge. The cars paraded through Hyde Park, and the first competitor left Westminster Bridge at 8.45 a.m. Thirty competitors completed the journey, some of them making the trip in a little over two and a-half hours. Of the four gold medals which were awarded for good performance, three were gained by British-built cars; they included an 1896 Daimler, an 1898 Stephens, and a 1900 Wolseley. The other medal was gained by a French 1901 Panhard. Every car which finished the run within the prescribed time limit of 6½ hours was awarded a bronze medal of honour.

A Definition of a Smoke Nuisance.

A decision which is of interest to manufacturers and industrial communities has been made by the Minister of Health with regard to a standard by which the degree of smoke emission from factory chimneys may be regarded as constituting a nuisance. At a public inquiry held at Bradford, at which the Corporations of Bradford and Leeds were represented, along with other local authorities in the West Riding of Yorkshire, it was proposed to make a new by-law under which smoke emitted for two minutes in any thirty minutes from each chimney of a building, each being reckoned separately, should constitute a nuisance. The Minister has decided to confirm this new by-law on November 24th, but he states that he does not feel warranted at the present time in confirming the proposed period of two minutes in any thirty. He has decided to substitute three minutes in any thirty, and proposes that this law should be given a trial for a reasonable period. If after, say, three years' working the authorities see fit to make a new application for the confirmation of a by-law fixing two minutes in thirty as a nuisance he will then consider it.

New Canadian Pacific Railway Steamers.

The new steamer "Princess Norah," which has been built for the British Columbia coastal service of the Canadian Pacific Railway Company, Ltd., by the Fairfield Shipbuilding and Engineering Co., Ltd., at Govan, left the Clyde this week on her 8000-mile voyage *viâ* the Panama Canal to Vancouver. She has a length of 250ft. with a beam of 48ft. and a draught of about 14ft. 3in., and is propelled by a single set of four-cylinder triple-expansion engines, steam being supplied by oil-burning Scotch boilers working under forced draught. Prior to leaving the Clyde, very successful trials were run on the Skelmorlie measured mile, and a speed of 16½ knots was attained. It is understood that the C.P.R. company will also shortly order two further coastal steamers for its service between the city of Vancouver and Victoria, on Vancouver Island. These ships are to have a length of 351ft. with a beam of 52ft. and a depth of about 19ft. They are to be ready for service in 1930. Further particulars are now available regarding the boiler plant of the new 40,000-ton C.P.R. liner "Empress of Britain," particulars of which were given in our issue of November 9th. The nine main boilers will be of the Yarrow patented high-pressure water-tube type, with Yarrow superheaters and air heaters. They will be designed by Yarrow and Co., Ltd., of Scotstoun, and constructed under licence by the builders of the ship and propelling machinery, John Brown and Co., Ltd., of Clydebank. In general, we understand, the new boilers will be of similar design to those which have given such good results in the C.P.R. "Duchess" class liners, and are to be installed in the C.P.R. liner "Empress of Japan," and the P. and O. liner "Viceroy of India." They are to be designed for a pressure of 425 lb., with a total superheated steam temperature of about 700 deg. Fah.

New York Central—Express Passenger Locomotives.

By E. C. POULTNEY, O.B.E.

No. II.*

Train Loads.

THE large "Pacific" type engines last mentioned, though of high capacity, were unable in certain instances to do the work required unless resort were made to the constant division of the heavier trains, with a consequent dislocation of other traffic. In order, therefore, largely to avoid the multiplication of the "Limited" Pullman car expresses, locomotives of much greater power became essential. Principally with the idea of operating expeditiously and economically such trains as the "Twentieth Century Limited," "The Empire State Express," "The Detroiter," "The South-Western Limited," "The Wolverine," and others in fewer parts or sections, the new 4–6–4 or "Hudson" type locomotives, of which we give a description below, were designed. Moreover, through the courtesy of Mr. F. H. Hardin and Mr. P. W. Kiefer, Chief Engineer of Motive Power and Rolling Stock, it is also possible to give some information in the form of the data obtained from an exhaustive series of tests made with the first "Hudson" type engine, No. 5200.

As reference has been made to some of the principal express trains running on the New York Central, which are hauled by the 4–6–4 locomotives, a tabulated statement, Table II., prepared by Mr. Kiefer, is presented. It gives the weight in tons—2000 lb.—and composition of the five express trains mentioned.

TABLE II.

	Name of train.									
	Empire State Express.		20th Century Limited.		South-Western Limited.		Wolverine.		Detroiter.	
Direction of running	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.
Average number of sections	1	1	3	3	1	1	1	1	1	2
Average number of cars per section	10	12	12	12	12	12	12	12	14	11
Average weight of train per section, tons	754	901	983	983	983	983	983	983	1151	901
Total distance of scheduled run, miles	438	438	959	959	1155	1155	973	973	690	690
Total scheduled time, hrs. and mins.	9 0	9 0	20 0	20 0	24 0	24 05	22 10	22 10	14 45	14 30
Number of regular stops	5	5	10	8	16	10	21	18	8	8

The number of parts or sections in which these trains are run, also the number of cars and the train weights furnished, are grand averages, taken over a considerable period of time and include both summer and winter season loading. Any one of these sections, with the exception of "The Century," may be on occasions composed of as many as fifteen or sixteen cars. "The Century," however, rarely, if ever, exceeds thirteen or fourteen vehicles. The train weights given, therefore, may at times be greatly exceeded, and the need for express engines of high power is thus apparent.

The mean speed, m.p.h., between termini of these five trains are as follows:—"Empire State Express," New York to Buffalo, 50·25; Buffalo to New York, 49·25; "Twentieth Century Limited," New York to Chicago, 49·5; Chicago to New York, 49; "South-Western Limited," New York to St. Louis, 48·7; St. Louis to New York, 49·25; "Wolverine," New York to Detroit, 47·8; Detroit to New York, 46·8; "Detroiter," New York to Detroit, 51·7; Detroit to New York, 53·7.

The "Hudson" Type Locomotive.

The chief factors governing the design of the new express locomotives consisted of certain clearly and sharply defined limits, for although a very considerable increase in sustained power at speed was the main essential, yet in overall height and width close conformity with the latest "Pacific" design of 1926 had to be followed.

In weight on the coupled axles also the new engines had not to exceed that attained with the previous design, because the 184,000 lb.—82·3 tons at 2240 lb.—carried by these locomotives marked the limit, if, as was required, the new engines were to operate without restriction over all the lines composing the New York Central system. This requirement also influenced the overall width dimension, and therefore the selection of cylinder diameter, whilst speed and total weight requirements dictated a six-coupled engine as opposed to one having eight coupled wheels, and likewise made it advisable to maintain the standard wheel diameter of 79in.

To deal efficiently with the work required it was necessary to produce a locomotive capable of handling very heavy trains at high average speeds on exacting schedules. These trains are made up of as many as eighteen Pullmans of 165,000 lb.—73·7 long tons—light weight each, or, say, a total of 1326 tons for a train. Moreover, they must be capable of running from 300 to 500 miles throughout all seasons of the year and have a margin of power available to meet emergencies.

In addition to these requirements the maximum working efficiency had to be reached, and it was desired to keep rail stresses and road impact loads as low as possible, in order to avoid additional permanent way upkeep costs. In fact, one of the major objects, and one which has been attained, was to produce a locomotive the operation of which would be much more economical with respect to rail and road stresses than the preceding designs, despite a very substantial increase in power.

In order to meet these very exacting conditions the 4–6–4 wheel arrangement has been adopted, for the reason that exceptional boiler capacity being needed, it was desired to provide means for carrying the added weight at the rear without excessive loads on the trailing or coupled axles. In respect to these requirements it is pointed out that an important consideration in connection with the question of rail stresses and road bed loads at high speeds is that of avoiding high maximum trailing wheel loads per pair of wheels. It is when such requirements are to be met that the four-wheeled trailing truck offers the combined advantage of providing for large fire-box capacity, and at the same time comparatively light individual axle loading.

Naturally, in order to meet the demand for exceptional steaming capacity at speed, the size of the boiler was the first consideration, extensive heating surfaces being essential, with an adequate grate in order to keep the rate of firing, even under maximum power conditions, within economical limits. At the same time, in view of the limitations set on the cylinder diameter, a fairly high steam pressure must be carried, and in this respect the pressure of 225 lb. adopted may, in view of the higher pressures now common, be taken as conservative. It can, however, be here pointed out that although the most efficient locomotive thus far produced to meet the severe operating conditions as outlined, constituted one of the aims of the designers; at the same time no very radical departure from conventional practice was desired. High power output with relatively simple and at the same time adequate machinery, combined with the use of well-proved auxiliary equipment, such as the feed heater and mechanical stoker, was favoured, as being likely to satisfy the requirements for high capacity and uninterrupted service.

Compared with the "Pacific" design of 1926 the following figures obtain:—

TABLE III.

	4–6–2 (1926). Class 462, No. 6510.	4–6–4 (1927). Class 464, No. 5230.
Rated tractive force	38,600	42,300
Total heating surface	5110 sq. ft.	6435 sq. ft.
Tubes and flues	3695 sq. ft.	4203 sq. ft.
Fire-box	222 sq. ft.	244 sq. ft.
Arch tubes	35 sq. ft.	37 sq. ft.
Superheater	1158 sq. ft.	1951 sq. ft.
Grate area	67·8 sq. ft.	81·5 sq. ft.
Engine weight	297,500 lb.	348,000 lb.
Adhesive weight	184,500 lb.	184,800 lb.

From Table III. it will be seen that while the rated tractive effort—engine cylinders only—has been increased by 10·9 per cent., the heating surface is greater by 26 per cent., so far as the total is concerned, and the relative fire-box surfaces show an increase of 11 per cent., and in grate area the increase is 20 per cent. The combustion factors—heating surface per unit of grate area—of 75·4 and 78·9 for the two engines being very similar, the boiler factors of 7·54 for the 4–6–2 and 6·58 for the 4–6–4 fairly show the great increase in steaming capacity, relative to that of the cylinders, obtained with the new engines.†

The large heating surfaces with the increase in the fire-box dimensions have brought about a correspondingly greater engine weight, and as that on the coupled axles is practically unchanged, the additional weight to be borne by the leading and trailing carrying wheels is the direct cause for the adoption of the four-wheel trailing truck design.

Boilers and Superheaters.

In general, the boiler and fire-box follow conventional practice in the United States. The fire-box wrapper is circular at the crown, and the inner box is supported by a system of direct stays. Thus the boiler is of the so-called "straight top" pattern. The barrel section, pitched with its centre line 10ft. 1in. from the rails, is composed of three rings. The centre course is tapered and carries the dome. The forward part is 82 7/16 in. in diameter inside, and the last, that adjoining the fire-box, has an inside diameter of 87 1/8 in. Over the tube sheets the length is 20ft. 6in., a dimension rather longer than is usual, owing in part to the absence of a combustion chamber, the omission of which has, together with improved weight distribution requirements, caused the use of a smoke-box of exceptional length. The distance from the front tube plate to the centre of the blast-pipe is not less than 82in., or 6ft. 10in. There are nineteen 3½in. and thirty-seven 2¼in. tubes and 182 3½in. flues.

The fire-box is of large proportions. It has a length inside of 130in.—10ft. 10in.—and a width of 90¼in.—7ft. 6¼in.—and furnishes 244 square feet of heating surface, and, with a further 37 square feet contained in the four arch tubes, the total is 281 square feet.

The grate area of 81·5 square feet is, the writer believes, larger than that found with any other six-coupled locomotive, except when anthracite "hard" coal is the fuel.‡ The front end of the fire-box is carried on the main frames by expansion shoes and at the rear by a vertical plate attached at the top to the fire-box foundation ring and at the bottom end to the cradle casting; a cast steel ashpan is provided. It is fitted with suitable discharging hoppers, and firing is accomplished by a Duplex stoker, pattern D.3.

The superheater is of the small-tube pattern, known as the "E" type; there are 182 elements, and the header has cast with it the housing for the American Throttle Company's multiple-disc throttle, which is operated by a rod running back to the cab outside the boiler on the right-hand side. A shut-down valve is mounted on the main steam pipe in the dome.

The top of the smoke-box behind the chimney and over the superheater header is detachable, which makes it possible to examine the throttle valves and also the unit bolt of the superheater elements without entering the smoke-box. Three 3½in. safety valves are provided, pressed to 225 lb. per square inch. Side and end views of the engines were given in Figs. 7, 8, and 9 in Article No. I.

Boiler Proportions.

The total combined heating surface of 6435 square feet has not previously been equalled for a six-coupled engine, and, as already noted, the grate area of 81·5 is the maximum thus far attained for a soft coal burning engine of the six-coupled design.

Particulars of the heating surface are as follows:—

Tubes	800 sq. ft.
Flues	3903 sq. ft.
Fire box	244 sq. ft.
Arch tubes	37 sq. ft.
Total evaporative surface	4484 sq. ft.
Superheater	1951 sq. ft.
	6435 sq. ft.

From the above it will be seen that the combustion factor, obtained by dividing the combined heating surface by the grate area, is 78·9 and that 4·36 per cent. of the total combined surfaces is in the fire-box and arch tubes. The fire-box surface of 244 square feet divided by the grate area gives a value of 2·98, and the superheater contributes 30·4 per cent. of the total heating surface. The total least area through the tubes and flues is 1391·04 square inches, or 9·66 square feet. The ratio of free area through the boiler to the grate surface is 11·8 per cent. and of the total tube area 81 per cent. is contained in the superheater flues.

Cylinders and Valve Gear.

An interesting feature in the design of the cylinders is the cast steel construction employed as a means of reducing the weight at the front end. Each cylinder with its valve casing and half saddle is in one piece, as when cast iron is employed, and the exhaust passages are formed in the castings in the usual manner. The cylinder barrels and valve liners are of Hunt Spiller cast iron. The diameter of the cylinders is 25in., the piston stroke being 28in. They are set 89in. between centres.

Compared with high-powered "Pacifics" in use on other lines, and also when comparison is made with the boiler capacity, as indicated by the extent of the heating surfaces, the cylinder volume seems small, and more especially is this so when it is noted that the trials made with the first of these engines have demonstrated the fact that steam pressure can be maintained with a cut-off as late as at 43 per cent. at 70 miles per hour. Broadly speaking, it would seem that, in the interests of the economical use of the steam, somewhat larger cylinders would have been advantageous, and indeed the adoption of 26in. cylinders was seriously contemplated. The provision of 26in. cylinders, however, presented certain difficulties. In the first place, the limited weight on the coupled axles decided the maximum tractive effort that could be developed, and the cylinder volume with a given steam pressure; and secondly, the importance of adhering to a definite overall width made the use of a larger cylinder diameter impossible, unless the centres were brought closer together, which, from the point of view of adequate crank pin bearing surfaces, was thought undesirable.

The piston valves have a diameter of 14in. and a full gear travel of 9in., when the cut-off is 84 per cent. There is a steam lap of 1 1/16 in., exhaust clearance of ¼in., and lead to the extent of ⅜in. The valve motion is Walschaerts', and it is controlled by a "Precision" power reverse gear.

Lubrication for the valves and pistons is provided for by a Nathan force-feed lubricator, placed just behind the right-hand cylinder and operated by a link

* No. I. appeared November 16th.

† See Table I., Part I., THE ENGINEER, November 16th.

‡ Since the first "Hudson" type engine was built some 4–6–4 type engines, having a grate area of 88 square feet, have been placed on the Atchison, Topeka and Santa Fé.

coupled to the upper end of the combination lever in the valve gear.

Wheels and Motion.

The six-coupled wheels have a diameter of 79in.—6ft. 7in. They are spaced 7ft. between centres and carry 182,000 lb., which, with a rated tractive effort of 42,400 lb., gives an adhesive factor of 4·3. The weight given is for the first engine built, No. 5200. For the fifty-nine subsequently constructed the adhesive weight is slightly increased.

The axles are hollow bored and are of carbon steel; the main journals are 11½in. by 14in. and have special axle-boxes fitted with supplementary bearings on each side below the centre line of the axle, which are securely held in position by wedges against shoulders on the lower edges of the crown brass. This form of main driving box was first developed by the builders for three-cylinder engines. The journals for the other coupled axles are 11in. by 13in. and the normal type of box is applied.

The leading truck has the usual rolled steel wheels; they have a diameter of 36in. and journal bearings 7in. by 12in., and the axles are bored hollow.

The four-wheeled trailing truck is one of the interesting details. The design follows in the principle of weight distribution and suspension the well-known Commonwealth Delta pattern two-wheel truck, the weight carried by both truck axles being equalised with the rear coupled axle on each side of the engine. The truck framing of cast steel swings from a pivot centre just behind the rear coupled axle and takes the weight at the rear by means of constant-resistance rockers at the hind corners, which bear on the underside of the cradle casting, forming an extension under the fire-box of the main frames, through which the tractive effort is transmitted to the engine and tender draw-bar. The truck wheels are unequal in size, the front pair of rolled steel being 36in.; those at the back are 51in. diameter, and have cast steel spoked centres and separate tires. The respective journal bearings ar 6½in. by 14in. for the leading and 9in. by 14in. for the trailing axles.

The motion details in general follow previous practice on the New York Central. Thus there is the usual type of two-bar crosshead, and in the method of carrying the expansion links and of guiding the valve spindles previous designs are followed.

The connecting-rods have a form of solid end with a floating bushing, a type which is becoming largely used. It has the dual advantage of light weight and of allowing, with safety, somewhat less clearances between the pistons and cylinder end covers. The material used for the connecting and side rods is normalised carbon vanadium steel, and the sizes have been carefully proportioned in order to minimise weight, an important consideration for fast-running engines, more especially when road bed impact loads are closely studied, as in the case of the present locomotives. The crank pins are hollow bored and are of carbon steel.

The axles and crank pins comply with the specification given in Table IV:—

Table IV.

Chemical Properties.

Manganese	0·40–0·70 per cent.
Phosphorus	Not over 0·05 per cent.
Sulphur	Not over 0·05 per cent.

Physical Properties.

Maximum outside diameter or overall thickness	Not over 8in.	..	Over 8in.
Yield point, minimum lb. per sq. in.	0·5 tensile	..	0·5 tensile
Tensile strength, minimum, lb. per sq. in.	80,000	..	80,000
Elongation in 2in., per cent.	1,800,000 / Tensile strength	..	1,725,000 / Tensile strength
Elongation in 2in., minimum, per cent.	22	..	20
Reduction of area, per cent.	2,800,000 / Tensile strength	..	2,640,000 / Tensile strength
Reduction of area, minimum, per cent.	35	..	30

The side rods and connecting-rods, which are of vanadium steel, are manufactured in accordance with the railway company's specification as follows:—

Table V.

Chemical Properties.

Carbon	0·45–0·55 per cent.
Manganese	0·70–0·95 per cent.
Phosphorus	Not over 0·045 per cent.
Sulphur	Not over 0·050 per cent.
Vanadium	Minimum 0·18 per cent.

Physical Properties.

Size.	Yield point, lb./sq. in.	Tensile strength, lb./sq. in.	Elongation in 2in. per cent.	Reduction of area. per cent.
Up to 5in. dia. or thickness	60,000	90,000	22	45
5in. to 9in. ditto	60,000	90,000	20	40
9in. to 13in. ditto	58,000	90,000	20	40

Balancing.

The whole of the revolving parts are balanced, and the percentage and division of the reciprocating parts balanced is as follows:—

Engine No. 5200.—39·6 per cent. of the reciprocating weights balanced. Divisions over the coupled wheels as follows:—First, 12·1 per cent.; second, 15·2 per cent.; third, 12·3 per cent.

Engines Other than No. 5200.—41 per cent. balanced. Divisions as follows:—First, 12·8 per cent.; second, 15·6 per cent.; third, 12·6 per cent.

Main Framing, Spring Suspension and Brake Gear.

The engine framing consists chiefly of two cast steel side frames running back from the front bumper to a point at the rear of the trailing coupled axle. The side frames are spaced 41in.—3ft. 5in.—apart and are 5½in. wide.

The boiler barrel is supported at two points in its length by vertical plates giving the necessary flexibility for expansion. Where these boiler supports are carried by the main frames transverse members of cast steel, which brace the framing transversely and also tie the top and bottom rails of the side frames together, are fitted. These cross braces also serve to carry the fulcrums for the spring equalisers. At the rear the frames are bolted to a steel cradle casting of rectangular shape, which forms the back end of the frame system and supports the fire-box as previously described.

The springs for the coupled axles are of the usual laminated type; they are placed above the axle-boxes and a continuous equalising system, connected at the rear to the trailing four-wheeled truck, is fitted. Wedge adjustment is provided for the axle-boxes of the coupled axles, and in conformity with usual practice the wedges are fitted to the rear horn checks. Brake blocks are applied to the leading truck wheels to the coupled wheels, and also to the rear wheels of the trailing four-wheeled truck.

For engine No. 5200 one cross compound Westinghouse 8½in. compressor is mounted on the right side under the front of the smoke-box, and on all the other locomotives two compressors of the same size are fitted, one on each side. Air sanding gear is provided. It supplies sand to the leading coupled wheels and to the rear truck wheels, which take the drive from the booster.

The Booster Application.

A Franklin type C.2 booster is applied to the hind axle of the trailing four-wheeled truck, and by its use the maximum tractive effort available at starting is increased by 10,900 lb.; thus the total rated tractive force becomes 53,200 lb. The use of the booster as a means of improving starting power and acceleration is generally recognised, and under the conditions ruling in so far as the design of the "Hudson" type locomotives are concerned, the booster is of great value in overcoming certain operating difficulties.

Starting from Albany, N.Y., westbound, the first 1000ft. or so are practically level, but on account of the number of points and cross-overs the use of sand to prevent slipping is prohibited, and from this point onward there is a stiff ascent for 1¾ miles at 86ft. per mile—1 in 61—combined with several curves, and the whole 3 miles up to West Albany are for the most part on rising gradients, varying from 1·55 to 1·63 per cent. For starting heavy trains over such a road the booster is most useful, and the "Hudson" type engines can handle passenger trains consisting of thirteen Pullman sleepers and one dynamometer car, a total load behind the tender of 1130 tons—2000 lb.—or, with the locomotive, 1408 tons, from starting at Albany to passing West Albany, a distance of 3·07 miles in 14 minutes, and in 9·37 minutes with a total of thirteen cars, or 1048 tons. The Albany gradient is the most difficult between New York and Chicago, travelling either east or westbound.

Feed Water Heating.

The first engine of this type, No. 5200, was equipped with the normal "Elesco" pattern feed heater and feed pump, the latter being of the twin-cylinder design, known as the constant flow C.F. pattern. This feed pump was fitted at the front end of the engine below the front of the smoke-box on the left side, a position which is particularly convenient, as it enables the pipe connections to the heater placed in the top of the smoke-box and ahead of the chimney to be both short and direct. Of the remaining fifty-nine engines, twenty-nine also have the "Elesco" arrangement, but an interesting innovation has been introduced in the construction of the feed pump, which, instead of being of the reciprocating kind, is of the rotary or centrifugal type. The arrangement is self-contained, complete in a casing, and is placed with the spindle in the vertical plane. The turbine wheel is in the upper part of the casing, and below the two-stage centrifugal pump is housed. In other respects the equipment is as usual.

The other thirty locomotives have a feed heater of generally similar design; that is, it is of the surface type, but the heater, instead of taking the form of a cylinder with tube nests running straight through in the longitudinal direction between tube plates, the heater casing is curved to a radius equal to that of the smoke-box. This peculiar construction enables the heater to be neatly housed either inside round the top of the smoke-box or, alternatively, outside, if desired, and further, as the tubes are necessarily curved, provision is at the same time given for their expansion and contraction, which simplifies the tube plate construction. This particular form is known as the Coffin feed heater, and, like the latest "Elesco" arrangement, a turbine-driven centrifugal feed pump is employed. It is fixed, however, in the horizontal position. The pump control in each case is a very simple matter, as the pumps may run slowly without creating sufficient pressure for feeding; but should the water supply fail, the pump—by an ingenious control arrangement—is automatically stopped. The same device also prevents the pump being run should there be no water in the tank.

In the case of both feed heating systems provision is made for the return of the condensate from the heaters to the tank or feed line, this arrangement being facilitated by the elevated position of the heater in the top of the smoke-box, which allows of the water passing away by gravity.

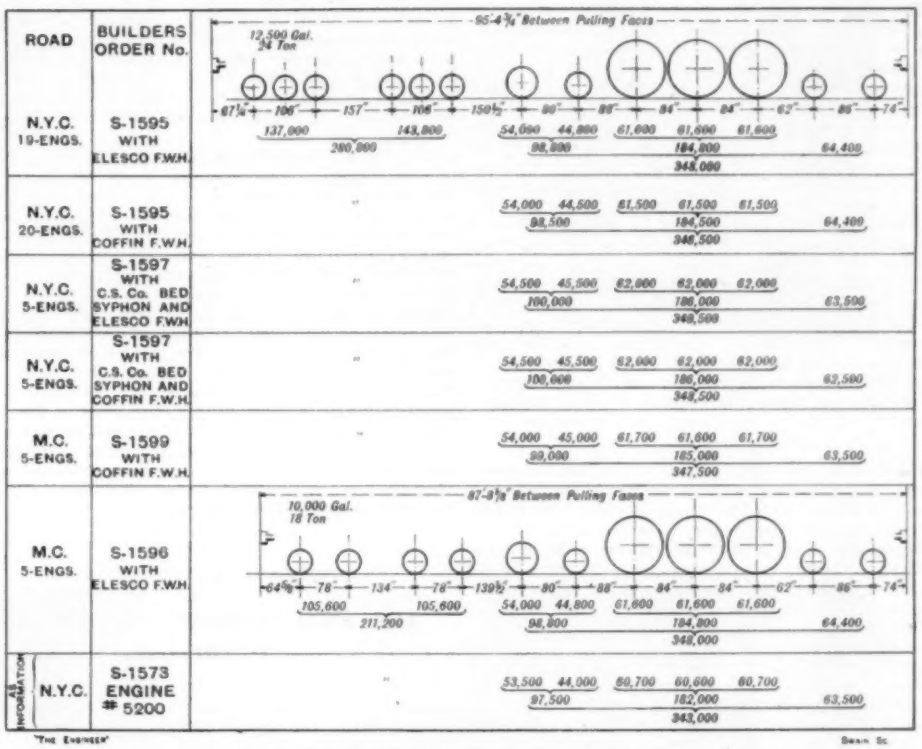


FIG. 10—DIAGRAM SHOWING DISTRIBUTION OF WEIGHTS

Wheel Spacing.

The total wheel base of the engine, including that of the tender, is 76ft. 1½in. for engine 5200, with the smaller eight-wheeled tender, but for the new locomotives with twelve-wheeled tenders it is 83ft. 7½in. The engines stand on a wheel base of 40ft. 4in., of which 14ft. is rigid, and the wheel base of the leading truck is 7ft. 2in. and the trailing truck 6ft. 8in. The distance between the centre of the leading truck and that of the leading coupled axle is 8ft. 10in., and between the centre of the trailing coupled axle and

the leading axle of the hind truck the distance is 7ft. 4in.

Weight Proportions.

There are some slight differences in the weights of these engines. These variations are due to a number of causes. In the first place, slight changes in weight are experienced even when engines are built from a standard design and when no important changes are made. For this there are various reasons, including, amongst others, variations in the thickness of boiler plates and in the thickness of castings. Where about 345,000 lb. to 350,000 lb. are involved for the weight of the engine alone in working order, it is difficult at times to account for small differences in weight, though, naturally, this point is one which is given close attention. Differences in the construction and in the equipment of the "Hudson" type locomotives account in general for changes in the weights. The Coffin feed heater equipment is rather lighter than the Elesco arrangement, and of the forty-nine engines allocated to the New York Central, nineteen have the Elesco and twenty the Coffin apparatus and the conventional form of two-rail cast steel framing. Five engines have the Commonwealth Steel Company's steel bed, fire-box, thermal syphons and Elesco heaters, and five have the integral bed, framing, syphons and Coffin heaters. Ten engines have different tenders specially arranged as regards the proportions of fuel and water carried to suit conditions on the Michigan Central all have the usual type of main framing and five received Elesco and five Coffin heaters.

The diagram Fig. 10 sets out in detail the official total and distributed weights, the wheel spacing, and the tender capacities for the various locomotives. The weight characteristics show that of the total engine weight about 54 per cent. rests on the coupled axles, 18 per cent. on the front, and 28 per cent. on the trailing truck. The total heating surface of the standard boiler without the syphons is 6435 square feet, and the weight of the heaviest engine without syphons is 348,000 lb., giving the low engine weight per square foot of combined heating surface of 54 lb.

Although in the case of very large locomotives it is relatively less difficult to obtain a low weight in relation to the heating surfaces provided, this ratio, nevertheless, indicates careful designing, especially when the weight of the four-wheeled trailing truck with the booster and the feed heating equipment are taken into consideration. The proportion of the total weight available for adhesion—about 54 per cent.—compares with about 60 per cent., which may be taken as an average figure for engines of the "Pacific" type.

Tenders.

The first engine built had an eight-wheeled double-truck tender, having a total weight in loaded condition of 212,000 lb. The water capacity was 10,000 U.S. gallons, and the coal space sufficient for 17 tons —34,000 lb. Fifty-four of the engines subsequently built have, however, been equipped with much larger tenders running on Commonwealth six-wheeled trucks. The water and coal capacity is increased to 12,500 gallons, and 24 tons—48,000 lb.—for forty-nine of the locomotives, and in the case of ten engines specially built for the Michigan Central Division five tenders are of the same size, but the water and fuel quantities have been varied in order to conform to the operating requirements ruling, and five have smaller tenders. All the tenders have a water scoop.

The larger tenders were adopted expressly for the purpose of extending the locomotive runs and to reduce as far as possible stops for coaling or taking water when track troughs are not available.

General Remarks.

It has been pointed out that the principal reasons for the building of these large engines were increased power and greater economy of operation; the latter, not only in the matter of better thermal efficiency, but also in respect to other improvements beyond the engines themselves, viz., in track maintenance. That power requirements and those appertaining to economical working at high rates of power output have been fully realised will be seen when particulars of the performance of engine No. 5200 are considered in the next article. In the meantime, however, it may be stated that when working with the valve motion arranged for a full gear cut-off of 65 per cent. a maximum of no less than 4295 I.H.P. has been developed, with a cut-off of 52 per cent. at 66·7 miles per hour, and at 60 miles per hour and with the same cut-off a maximum of 3760 dynamometer horse-power has been recorded. These are the highest powers realised. On the basis of the cylinder power given the engine weight per ho se-power comes out at the extremely low figure of 80 lb., and per draw-bar horse-power the weight is only 91 lb.

The "Pacifics" of 1907 weighed, engine only, 261,000 lb., and at about 45 miles per hour were capable of developing a maximum horse-power at the back of the tender of 1760, giving an engine weight per unit of work on the draw-bar of 148 lb. The weight per horse-power for the new engines, in spite of their much larger tenders, is therefore but 62 per cent. of that formerly necessary; surely a notable advance.

Even more significant, however, are the comparative driving wheel weights per dynamometer horse-power. The engine of 1907 had an adhesive weight of 167,700 lb. for a maximum of 1760 D.B.H.P., and No. 5200, the first 4–6–4 of 1927, has 182,000 lb. on the drivers for a maximum of 3760 D.B.H.P., figures which give 1 D.B.H.P. for 95 lb. and 48·3 lb. of weight on the drivers for these two engines respectively.

With a train of twenty-six cars the new 4–6–4 locomotive has given an excellent account of itself, for it has averaged 55·49 miles per hour and developed a maximum sustained power of 2986 I.H.P., and the best water rate per I.H.P. is as low as 15·04 lb., including all auxiliaries, whilst cylinder feed only has averaged as little as 13·58. The combined boiler, feed heater, and superheater efficiency has averaged 84·5 per cent.

In general, considerable attention has been given to the design and arrangement of the detail parts. The number of brackets on the boiler has been kept down. The power reverse gear and operating valve are carried on one bracket on the right side of the engine, as are also the feed lubricator for the cylinders and valves, and the condensate steam trap for the heater. The Elesco feed heater is carried on a shelf formed in the top of the smoke-box, and all piping has been symmetrically arranged to avoid irregular lines as much as possible. The sand pipes and traps are placed under the boiler lagging sheets, and the turret supplying injector steam and for other purposes is housed in a covering just in front of the cab. The steam valves are operated in the cab by means of extension handles. American locomotive designers have, as a rule, shown little care for appearance, and they deserve, in this case, to be congratulated upon a move towards British designers in this respect.

(To be continued.)

The Peat Industry at Alfred, Ontario.

The production of peat fuel in the Dominion of Canada, in such quantity as would afford reasonable assurance of a fair reserve supply for domestic use at all times, is a prediction which seems to be in a fair way of fulfilment within the next few years. It is fortunate that the greater number of Canada's peat bogs are situated within what is known as the "Acute Fuel Area," which comprises the provinces of Ontario and Quebec. This area, owing to excessive transportation costs on Canadian coal from both eastern and western mines, is almost entirely dependent on imported coal.

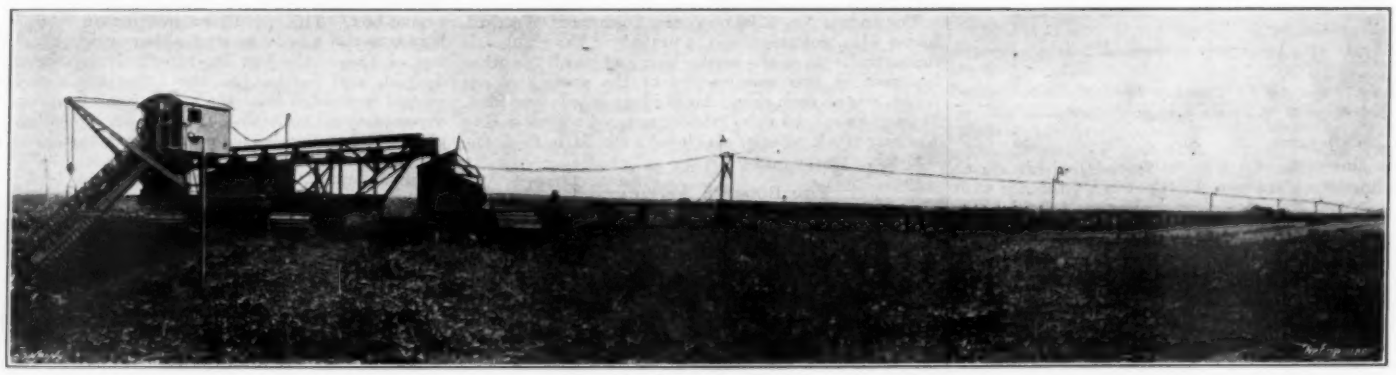
Approximately 11,000 square miles of peat bogs are found in these two provinces, and a considerable percentage of their contents is suitable for the preparation of peat fuel. Twenty-two bogs, containing an estimated reserve of eighty-seven million tons, are found in close proximity to large centres of population, including Montreal, Toronto, Quebec, and Ottawa, and it is from them that a yearly production of half a million tons of peat to be marketed, not only as an industrial fuel, but also as an auxiliary to coal for domestic purposes, is predicted. Economic conditions, such as transportation facilities, labour and power, are favourable, and thanks to the excellent quality of the peat fuel produced, during experimental work at Alfred, Ontario, a large market is anticipated.

The history of the early development of the Canadian peat fuel industry has been largely one of disaster, owing to failure to study and understand the outstanding physical properties of peat and to a failure to take advantage of previous experience, which involved the expenditure of millions of dollars. In recent years, however, the problem has been approached along sound lines, and a process has been developed by the Peat Committee of the Dominion and Ontario Governments that promises success. An important factor, overlooked by early experimenters, was the colloidal nature of the peat, which makes it difficult to remove the surplus water by the application of pressure. A second unrecognised factor was that the price obtainable for the fuel prohibited the reduction of the water content by artificial drying methods. Even if the same degree of success in actually manufacturing marketable peat fuel had attended these early ventures, as was later achieved by the Government experimental plant, the commercial possibilities of such an undertaking were severely handicapped by the fact that good American anthracite was available at that time at less than 7 dollars per ton delivered. To-day a much poorer grade of anthracite costs 16 dollars or more in Canada.

The earliest attempt to produce and market peat fuel in Canada was made by James Hodges, an English engineer, in 1864, at a peat bog near Bulstrode, Quebec. This venture, together with two or three others of a similar nature attempted a few years later, failed. In 1890 a marked revival of interest was evidenced, and from that date several companies endeavoured to produce peat fuel, mostly in the form of briquettes, at a number of places in the Dominion.

Several methods of removing the surplus water were resorted to, including the treatment of the raw peat in powerful hydraulic presses; in drying kilns heated with coal, wood and peat; and in drums, subjected to steam under pressure followed by hydraulic treatment. None of these schemes proved financially successful, but the project was not allowed to drop, for several far-sighted public men, who realised the importance of utilising Canadian peat resources, pressed the matter so strongly that, in 1908, the Dominion Government decided to investigate the industry abroad to determine whether any of the European peat fuel processes would prove suitable for economic operation in Canada. As a direct result of this investigation a small commercial plant, imported from Sweden, was installed and operated during 1910 and 1911 at the bog at Alfred, Ontario, by a Swedish engineer. By this installation the Government was able to demonstrate (1) that a fuel could be produced from the raw peat pulp; (2) that that fuel could stand transportation; and (3) that it could be burned in ordinary types of heating apparatus. No effort was made at that time to demonstrate the commercial possibilities of the proposition, and over 3000 tons were sold at less than cost to introduce this new fuel to the public. The Federal Department of Mines, in an endeavour to discover industrial uses for peat fuel, did extensive experimental work, particularly with regard to its utilisation in gas producers for generating power, and in 1912 presented a very comprehensive report on the subject. A report on the use of peat fuels for the generation of steam was also published in 1917. In 1912 a private company constructed a plant of the Anrep type on the Alfred bog, and secured excellent results in a trial run; but just as plans to commence operations on a commercial scale were completed war was declared, the promoters withdrew their financial assistance, and the project was dropped.

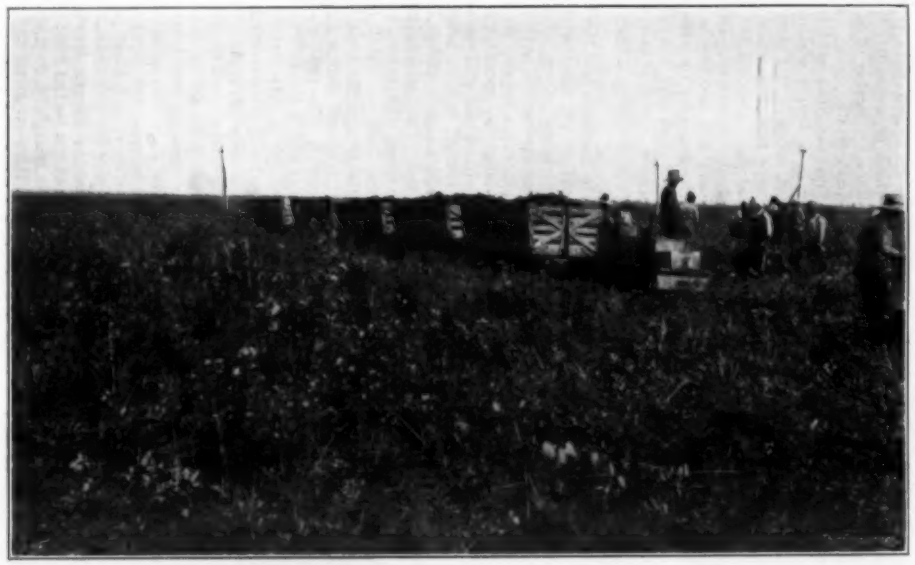
Outside pressure was again brought to bear on both the Ontario and Federal Governments in 1918 during the fuel shortage. It resulted in the joint appointment, by the two Governments, of a committee to investigate the desirability of utilising Ontario's vast



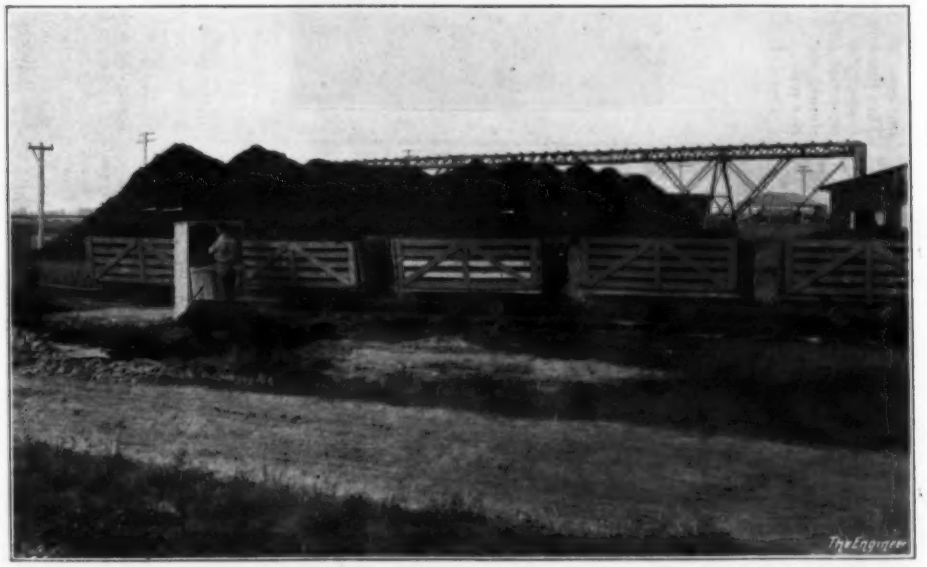
Panoramic View of Peat Winning Equipment on the Alfred Bog

THE PEAT INDUSTRY AT ALFRED, ONTARIO

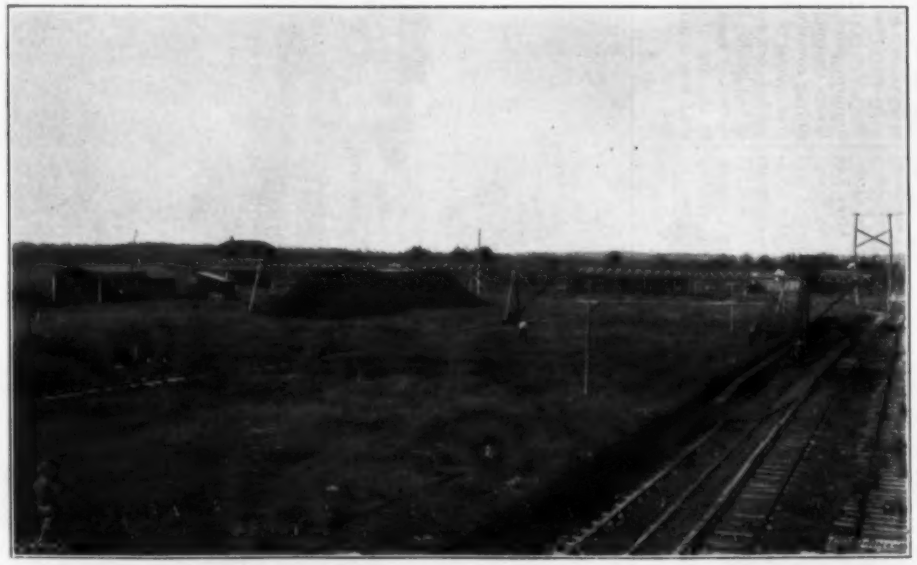
THE HUMUS PLANT



HARVESTING OPERATIONS—LOADED CARS IN FOREGROUND



WEIGHING-IN HARVESTED FUEL



STORAGE YARD AND LOADING ELEVATOR

peat resources in the production of domestic fuel. This committee, after carefully investigating all the processes for producing peat fuel throughout the world, decided that the production of "air-dried machine peat" seemed most feasible, and proceeded to develop a plant for its production under the direction of E. V. Moore, consulting engineer. After five years of experimental work, during which the Moore and Anrep systems were thoroughly investigated and much new machinery designed and tested, the committee, by effecting a combination of the two systems, was able to secure a smooth working unit and to demonstrate the commercial feasibility of the process. As the aims of the committee were of an entirely investigatory nature, the plant was closed down to await the advent of private capital. The Peat Committee presented an interim report in the spring of 1923. Some of the problems met and solved during the course of plant development were :—

(1) The necessity of treating 7 tons of raw peat to secure 1 ton of fuel.

(2) The economic reduction of the water content of the peat to a suitable degree by sun and air drying.

(3) The operation of heavy machinery units on a surface incapable of safely carrying more than 2–3 lb. per square inch and the designing of such machinery to provide sufficient strength with minimum weight.

(4) The development of a mobile plant for providing power.

(5) The excavating of peat in the presence of undecomposed roots and logs.

(6) The thorough shredding and mixing of the peat pulp.

(7) The continuous transportation of the mixed pulp to all parts of a large drying area, with minimum labour requirements.

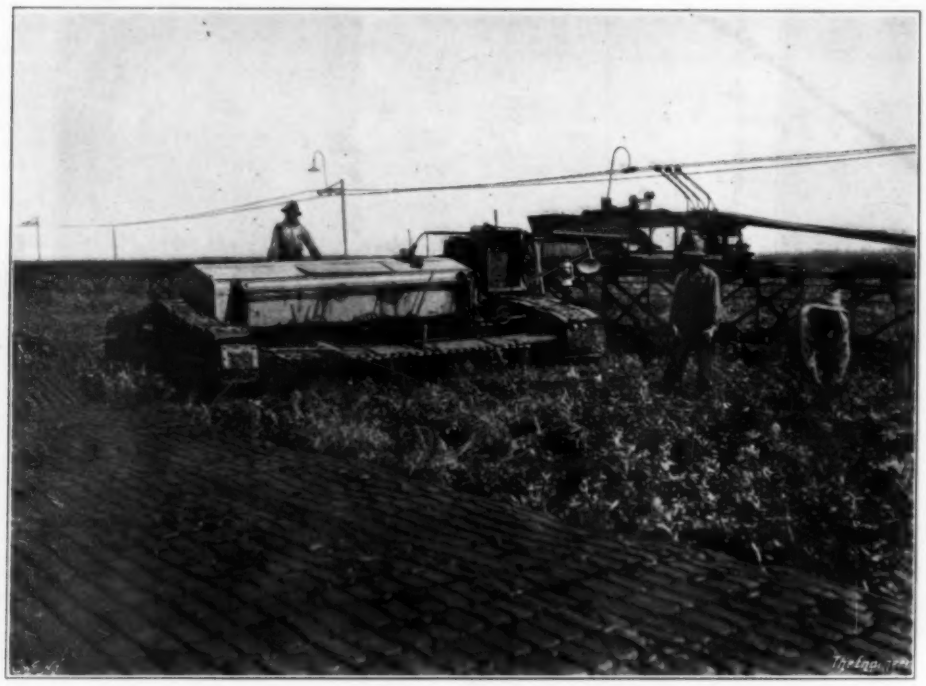
(8) The uniform spreading of the peat on the ground, and

(9) The harvesting and transporting of the completed fuel economically.

In 1924 Peat Fuels, Ltd., of Montreal, was formed to operate the bog at Alfred. The entire plant and equipment, under an arrangement with the Federal Government, was taken over by the new company, and in June, 1925, after completing the power line and electrifying the plant, the company commenced operations on a commercial scale and continued until the autumn of the same year. In 1927 the same company operated a small plant for the production of peat humus.

The peat plant at Alfred is now being operated on a commercial scale by the Federal Department of Mines. The peat-winning machinery was recently remodelled according to the recommendations of the Joint Peat Committee, and the plant, after receiving a preliminary tuning up last autumn, underwent several necessary alterations during the spring of this year. It was then placed in operation and, despite an unusually wet season, produced fuel all the past summer. The entire plant, including a well-equipped machine shop, is electrically operated, power being supplied from Hawkesbury by the Gatineau Power Company. Transportation at the bog is supplied by a light railway system employing 3-ton petrol locomotives for motive power. By this means, and by the utilisation of portable tracks on the drying field, the peat fuel is harvested when dry and conveyed to the storage yard. Shipping facilities are excellent. The storage yard is equipped with a travelling distributor and elevator capable of screening and loading into railway cars at least 150 tons of fuel per day.

In most peat bogs the upper layers are less humified than the lower ones. Hence, in order to secure a uniform product, it is desirable to mix the different layers thoroughly. At Alfred that process is effected during removal from the bog by a specially designed continuous bucket and chain excavator, in which the buckets are drawn in a sloping cut from bottom to top of the bank. The excavating member is moved automatically back and forth, advancing from 4in. to 6in. in the line of excavation at the end of each cut. In that way a prism 30ft. wide and the full depth of the bog, usually from 6ft. to 9ft., is removed. The excavator, which is supported on three caterpillars, moves forward along the working surface of the trench and has a capacity of 150 cubic yards per hour.



SPREADER LAYING OUT PEAT TO DRY

From the excavator the raw pulp is delivered by a screw conveyor to a large swing hammer macerator, in which several sets of steel hammers pound the incoming peat at the rate of over 80,000 blows a minute. This machine is driven by a large motor and has a capacity of 150 cubic yards per hour. Its sturdy construction and free swinging hammers prevent breakage should any foreign material enter the machine with the pulp.

Probably the most interesting mechanical problem in the process is the transportation of the peat pulp to the drying field. About 700ft. of drying surface are required for every ton of peat fuel produced. Therefore, for a production of 175 tons per day, assuming a drying period of forty days a drying area of 120 acres is necessary, every part of which must be readily reached by the transportation system. Transport has been found to be best effected by a belt conveyor, which receives the peat from the macerator and delivers it to the spreader. This belt, which has a length of 850ft. between centres and weighs 4½ tons, is, we understand, by far the largest single-span portable belt conveyor ever attempted for practical use in the manufacture of peat fuel. It is supported by ball-bearing steel idlers carried on a steel truss work. The entire conveyor may be moved forward in a direction parallel to its own length, with power from the macerator motor, which is transmitted to the eleven supporting caterpillars by means of a cable wound once around each drive shaft.

PEAT DRYING FIELD

The fourth and final machine used to prepare the peat for air drying is a device which moves along under its own power, receives the peat continuously from the belt conveyor and deposits it in a uniform layer 12ft. wide and 5in. deep on the drying field. This strip of peat, which contains on an average 16 tons of fuel, is automatically cut into blocks 4½in. by 10in. It is claimed that the spreader distributes peat pulp much more uniformly than any machine heretofore designed for the purpose, and it is largely responsible for the exceptionally uniform quality of the fuel obtained.

After a row of pulp has been laid the belt conveyor and spreader move forward on the drying field a sufficient distance to make room for the next row of peat. During this operation, however, the excavator remains stationary, a hopper on the belt conveyor being long enough to permit the spreader to move to the new position and still receive peat from the excavator. A 4000ft. trench, bounded on each side by a drying field roughly 4000ft. by 1000ft. in area has been provided. The plant moves up one side of the trench and down the other, covering both drying fields with peat pulp *en route*. By the time a complete circuit of the trench has been made the first peat to be laid is harvested and a second cycle of operations is commenced. The peat is allowed to dry for ten or twelve days and is then turned with a rake to expose the under surface. Air drying is continued until the briquettes become converted to fuel, the total drying period usually occupying thirty to forty days, depending on weather conditions.

Probably the most difficult operation from the standpoint of labour economy is the harvesting of the dried peat fuel. The harvester consists of a metal trough, long enough to span four rows of peat, which is suspended between two caterpillars just far enough from the ground to clear the dried fuel. In harvesting operations this machine moves forward under its own power at right angles to the rows of peat, which are shovelled into the trough by men with coke forks. A drag chain moves the peat along the trough, up an incline and into a dump car on a portable track. Both drying fields have a permanent narrow-gauge track along each side and a supply of portable tracks to be laid between each eight rows of peat as required. The filled dump cars are collected by a petrol locomotive, hauled to storage, emptied and returned for re-filling. A storage which has a capacity of 10,000 tons is equipped with a combined elevator and belt conveyor. This machine unloads and piles the harvested peat, also screens out the fines and loads the peat fuel on freight cars at the rate of 10 tons per hour. The working section of the bog is served by a narrow-gauge track system on which all marketable fuel is hauled to the storage yard, supplies transported to the plant from the railway station and inspection and control carried out.

A series of engravings illustrating this interesting plant is given herewith. They have been reproduced from photographs taken by the Department of Trade and Commerce, Canada, and they speak for themselves.

Institution of Mechanical Engineers

THERE was a large attendance of members at the meeting of the Institution of Mechanical Engineers, which took place on Friday evening, November 16th, when a paper on the mechanics of belt drives was presented by Dr. H. W. Swift, of Bradford.

Before calling upon Dr. Swift to read his paper, the President, Mr. Richard Allen, announced that the Council had that afternoon elected Sir John A. F. Aspinall, Past-President, an honorary life member of the Institution. The announcement was received with acclamation. The President made the further announcement that the Council had nominated Mr. Daniel Adamson, of Manchester, Vice-President, to be President-elect for the 1929 session.

POWER TRANSMISSION BY BELTS.

In introducing his paper on "Power Transmission by Belts: An Investigation of Fundamentals," Dr. Swift said that the importance, from a practical standpoint, of a proper understanding of the principles which controlled the operation of belts needed no emphasis. The intermittent loss of production owing to belt failures and the small but continual loss of production due to belt slip were matters which, in days of narrow margins, the manufacturer could ill afford to neglect. The actual cost of the loss of power which occured, day in and day out, owing to belt slip and bearing friction might easily be sufficient to dwarf any considerations of the initial cost of belting. In these circumstances he thought that it was rather surprising that so little attention had been devoted in this country to a proper understanding of belt operation, and that there should be room for so many

differences of opinion and misconception on a matter which after all was basically dependent on the ordinary laws of mechanics. It was true that here and there, both in British and foreign technical papers, evidence was to be found that certain workers had, in an isolated way, seen light through many of the points of fundamental difficulty. It was equally true, however, that in most cases their work had been either rejected or at least neglected by later writers. It had to be admitted also that the information which was generally accessible to the industrial engineer at the present time was not appreciably more complete than that which was available thirty or forty years ago.

When this fact was realised it became clear that any systematic inquiry which aimed ultimately at helping to improve the utility of the belt drive could only start with confidence at one point, and that was at the beginning. It was for that reason that the paper to

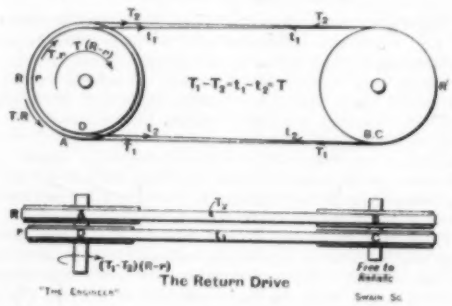


FIG. 1

be discussed bore its warning and perhaps forbidding sub-title, and that considerable attention had been devoted to questions which to the practical engineer might seem to be purely academic.

Method and Experimental Results.

The actual paper was too long to read in full, and Dr. Swift explained very clearly by means of a working model and lantern slides the principles underlying the use of the return drive method, and the plant with which his experimental work was carried out, after which some of the more significant of the results were dealt with.

The principle of the return drive, which distinguishes the method employed from those previously used in belt testing machines, was demonstrated experimentally at the meeting, on a model similar to that shown in Fig. 1. B and C are pulleys of equal diameter keyed to a single shaft, which is free to rotate in its bearings. The two other pulleys A and D, of

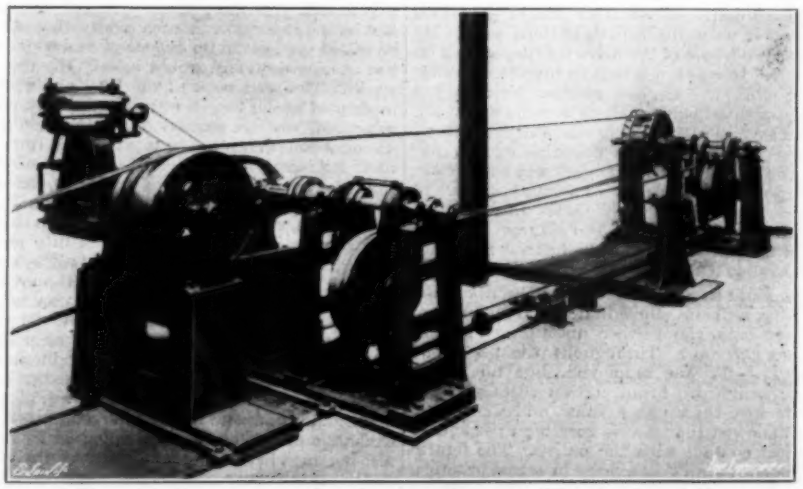


FIG. 2—TESTING PLANT FOR BELT TRANSMISSION

slightly unequal diameter, are keyed to another shaft and the system is belted up as shown. When the system is in steady motion the tensions in the two belts are as indicated. Considering this system, Dr. Swift showed that since the shaft B C was free, the two tension differences on the pulleys must be exactly equal and opposed, quite irrespective of any slip which might be taking place. In the case of the shaft A D, since the belts acted at slightly different radii, there was a small out-of-balance moment. In order to maintain the motion it was necessary to supply this out-of-balance moment from an external source. It acted in the direction indicated by the arrow. Assuming that such a moment was supplied, the belt A B then virtually transmitted power in the direction from A to B corresponding to the turning moment T R, and the belt C D returned power in the opposite direction corresponding to T r. The balance of power supplied from outside corresponded to the small difference in these powers and covered the loss due to slip in the two belts. The actual value of the tension difference depended on the fact that the total slip in the two belts when added together corresponded to the difference in the diameters of the two pulleys A and B. For fixed initial conditions the slip and the turning moment were definitely related, and for a certain turning moment there was a definite corresponding slip. Hence by simply altering the amount of slip in the system a ready means was provided of controlling the turning moment transmitted through it.

In the actual testing plant shown in Fig. 2 the test drive, which is seen in the foreground, corresponds to the forward drive A B, and the return drive is shown in the background. The principle of working

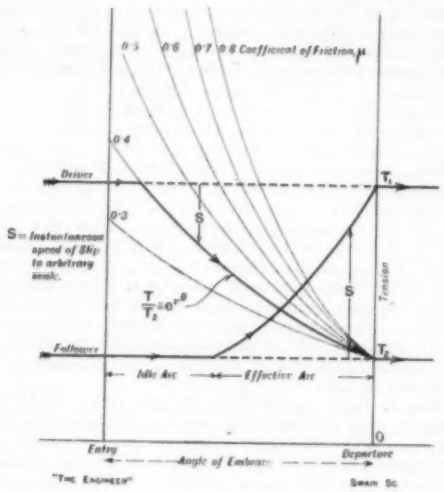


FIG. 3

is the same as that illustrated in Fig. 1, except that for convenience of manipulation the slip is controlled by means of an adjustable pulley. A transmission dynamometer and a load strain recorder form part of the apparatus.

From the theoretical point of view the most important result obtained, said Dr. Swift, was the confirmation of the rational conception that creep was nothing more or less than local slip. The theory on which this result was based was outlined in the paper, and experimental results were given in the paper which, if taken in conjunction with the observations made by Mr. R. F. Jones, in America, established the theory, he thought, beyond any reasonable doubt.

Dr. Swift illustrated the meaning of his conception of local slip by the diagram reproduced in Fig. 3, in which the tension is plotted at various points round the arc of contact of a belt with its pulleys.

Considering the driving pulley at the point of departure, the tension was T_2. As the different points were traced back along the arc of contact the value T_2 decreased according to the well-known law until the point was reached where it became equal to the tension in the tight side of the belt T_1. Between the point of entry and the point just referred to there was no change of tension and no frictional action so far as power transmission was concerned.

On the follower the tension at the point of departure was T_1. If points were traced successively back along the arc of contact the tension values fell in accordance with a similar law until a point was reached where the tension was the same value as the tension on the slack side of the belt. Between the point of entry and this point there was again an idle arc over which no direct action occurred.

Diagram Fig. 3 represented a case in which the frictional coefficient on the follower was greater than that on the driver, so that the idle arc was also greater. By adapting the model exhibited at the meeting—see Fig. 1—Dr. Swift showed very effectively that as the power and therefore the tension ratio was increased the effective arc became greater until it extended over the whole of the available arc of embrace in one or other of the pulleys, whereupon bodily slipping occurred. This feature was illustrated by a radial arm carrying a light spindle which was gripped between the underside of the belt and the face of the pulley, and was provided with a light disc marked out in black and white sectors on its outer face. When no slipping occurred the disc was stationary, but it began to revolve immediately slipping took place, and it served to illustrate very clearly the above-mentioned points.

The term "idle arc" denoting the non-slipping entry arc did not infer, the author pointed out, that that part of the drive was by any means an unimportant one. It might, in fact, be termed the rudder of the drive, determining whether or not the belt would run on the pulley. An example of this function was to be found in the case of the twisted drive. Unless the oncoming belt was at right angles to the axis of the pulley it was carried off at the edge purely under the action of the non-slipping arc. The non-slipping arc also enabled a belt to resist the tendency to slip down a crowned pulley, and it sustained that bending action which carried the belt on to the crown. When the idle arc ceased to exist and bodily slipping took place, the action of the crown no longer availed and the belt came off.

The quantitative results given in the paper were obtained under basic conditions. Possible centrifugal and bending effects were eliminated and the drives were of the open horizontal type with pulleys of equal size. Complicating factors might form the subject of a later study. In interpreting the results it was sought

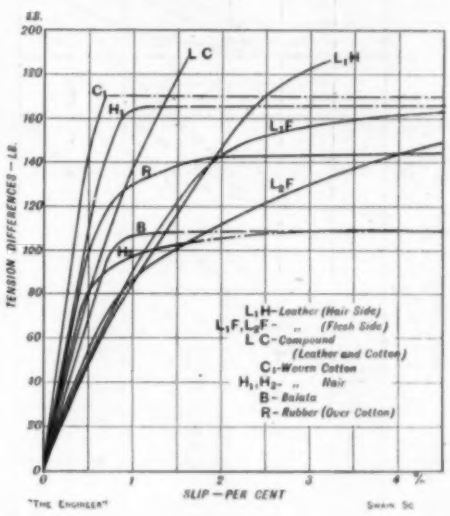


FIG. 4

to introduce simplification by making the tests in two series. In the first series the mean belt tension was kept constant during each test, and power-slip relations termed "slip characteristics" were determined, while in the second series of tests the pulleys were kept at a constant centre distance and the changes in the mean tension consequent upon the alterations in the power transmitted were measured.

Fig. 4, taken from the paper, shows a number of slip characteristics for different 2in. belts at a mean tension of 100 lb., or 50 lb. per inch in width. At the low powers the slip was entirely due to creep and the less extensible fabric belts gave steeper characteristics than the more extensible leather belts. At the higher loads, however, the slip became more important. Again, it was shown that the ultimate tension difference which a belt could transmit was determined by its frictional properties. They, as indicated in Fig. 4, varied over a wide range for belts of a similar class according to the treatment received in manufacture and the presence or absence of dressing. The characteristic difference between leather belts run on the grain or flesh side was also illustrated by this diagram. The creep was an elastic function and was practically unaffected, but the frictional properties and the ultimate power were very different in the two cases.

Fig. 5 illustrates some of the tests made with pulleys maintained at a constant centre distance. The light running tension was adjusted to a prearranged value before each test, and various turning moments were applied, the mean belt tension being read. From these results the tension characteristics shown in Fig. 5 were plotted. The particular results given are for a horizontal drive of and for 20in. pulleys with woven fabric belts. The changes in mean tension were shown to be dependent upon at least three factors. Firstly, belting of all kinds became less extensible at the higher tensions, so, as the tension difference increased, the mean tension also increased. The extent of this tightening depended upon the elastic properties of the material and might

amount to something like 30 per cent. of the initial tension. A further tightening was caused by the fact that the tension around the pulleys did not vary uniformly. This effect was small and only became appreciable in the case of short vertical drives.

Again, with a horizontal drive the most important tightening factor was the catenary form of the free belt between the pulleys. In the example given in Fig. 5 that factor caused the tension to increase in a very marked way. It was that factor which made the horizontal drive preferable to the vertical drive. The results clearly showed that the rise in tension depended on the value of a certain product, and the longer the drive the heavier or wider the belt, and the lower the initial tension the greater was the tightening effect. The tightening property was a valuable one from many points of view. It helped a belt to carry occasional overloads without the need for an excessively high tension at normal loads, and it made the capacity of a belt with good frictional properties less dependent than it would otherwise be on the exact value of the initial tension and less sensitive to small amounts of permanent stretch.

Finally, Dr. Swift drew attention to the latter part of his paper, in which some experiments on the effect, of jockey pulleys or gravity idlers were described. These sections of the paper threw light on the means by which a jockey pulley secured an increase in the load without slipping. It was shown that the primary effect of a jockey pulley on the slack side of a belt was to cause the belt to tighten as the load was increased, and that this effect was generally much greater than the incidental improvement of the frictional properties of the drive by an

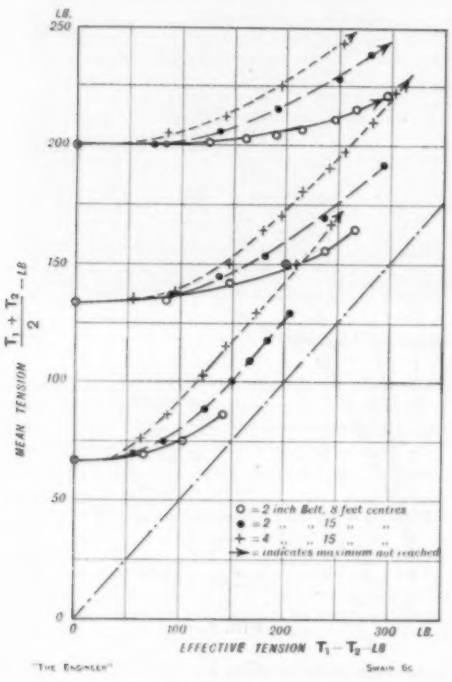


FIG. 5

increased angle of lap. The most effective position for an idler was found to be a matter for consideration in each individual case. The tightening property was the greatest when the idler was midway between the pulleys, but when one pulley was much smaller than the other the angle of contact on the small pulley was most improved when the idler was placed close to it. The tests made showed that in some cases the idler was most effective when set close to the small pulley and in other cases nearer mid-span.

In moving a vote of thanks to the author for his paper, the President asked him whether it was possible to apply his methods and apparatus to the study of the working of high-speed belts such as were commonly used in modern practice.

Mr. H. C. Young, opening the discussion, suggested that Dr. Swift's apparatus might be used to carry out tests on the ultimate strength of belts. Such tests made in the ordinary way were difficult to conduct, because of the trouble encountered in devising a satisfactory means of gripping the ends of the specimen. He found only one difficulty in the paper, namely, in accepting what the author called the coefficient of performance of a belt. He (the speaker) argued that belts giving a high coefficient of performance were not necessarily the best belts.

Professor G. F. Charnock held that the results given in the paper were quite beyond question, and that they would clear away the imperfections of the ordinary theory of belt driving, the deficiencies of which had prevented belt drives from being designed on a rational basis. The most striking fact brought out in the paper was the connection between slip and creep. The common means of curing slip or creep was to tighten up the belt, and as a consequence many belts were being run under much too high a tension. Dr. Swift did not attempt to show any practical applications. The concluding part of his paper showed very clearly the advantage of the idler pulley or "Lenix" drive. A statement had appeared, the speaker believed, in a German paper to the effect that the idler pulley might be applied with advantage to the tight side of a belt. That application appeared to be unreasonable, and as Dr. Swift had made experiments on it, perhaps some results might be given.

Mr. P. Monteith suggested that it was about time that engineers began to take interest in belts. With woven belting the tensile strength could be tested without having to cut the belt. Rubber belting was not truly elastic, and fabric belting could not be elastic. The outstanding factor which enabled good belting to be distinguished from bad belting was its response to the hysterises loop test in which the belt was subjected to a momentary shock, and, if a good belt, recovered without permanent extension. He put forward the suggestion that this test might form the bases of a belt test specification.

Mr. E. R. Dolby said that the author had taken evident care in obtaining his results and presenting them. In the earlier part of the paper there was, however, some conflict between rational methods of design and empirical facts. The experiments with the leather belts run on the grain and hair sides seemed to favour the American practice of using the hair side as against the British way of employing the grain side. There was no reference to the well-known type of belting which was built up by a number of strips fixed together edgewise, and which gave excellent results. The conclusions were slightly disappointing. Dr. Swift did not indicate whether he considered the usual formulæ and constants to be reasonably accurate or not.

Mr. J. Dawson, of Dawson and Sons, Ltd., of Lincoln, said that the figures given in Table I. in the paper established the creep theory to be sound at belt speeds of 1000ft. per minute. At higher speeds, however, a supplementary theory might be needed. The figures given in the table referred to should be taken as representing the belts tested and not as types. The fact that a high-speed belt suddenly thrown off a pulley retained its shape, showed that belt speed was a controlling factor. The catenary tightening criterion could only be applied to slow-running belts. With regard to the tests made on gravity idlers, these were very general in character, and not representative of practice. Such drives were really useful for short centres and high speeds.

Mr. J. R. Hopper dealt briefly with the practical aspect of belt driving and expressed doubt that the results arrived at by Dr. Swift would be found to be corroborated in actual practice.

Mr. Noel Godby, speaking as an industrial engineer, said that he was surprised to find belt driving such a scientific subject. The bogey of increase and loss of output was mentioned too often. In the flour milling industry, with which he was connected, automatic machines weighed out a certain amount of corn which must be delivered as flour within a certain time, no matter what the belt conditions were. He thought that the whole of the drive was dependent on the belt joint. It was important to investigate what kind of belt joint gave the best results. Fully 90 per cent. of the patented belt fasteners were no use at all. At one time leather was the only material for belting, but now every type of textile material, except silk, was employed, including cotton, wool and camel hair. It was necessary to determine what material and in what form gave the best results under different conditions. The inaccuracy of the figures given in horse-power absorbed by most industrial machines made it impossible to design a belt drive with accuracy.

Mr. D. M. Hunt said that the author had asked the question why a belt slipped down a cylindrical drum. There was the further question, Why did it sometimes slip up? Throughout the paper the expression $T_1 - T_2$ was employed, but no actual values were assigned. From certain cases given it was possible to estimate that value, and the figures so obtained showed that it was very high per square inch of arc of contact with the pulley. The figures were much higher than those in use in actual practice. Neither creep nor slip occurred in a well-designed belt drive, because the stresses were lower. Speed was an important factor. He suggested that Dr. Swift should continue his experiments and extend them to embrace the life of belts and belt thicknesses relative to pulley diameters.

Dr. Swift, in his reply, dealt briefly with the remarks of the first two speakers, and said that he would deal with the other speakers in his written reply.

With regard to Mr. Young's remarks on tensile strength, he agreed that the main trouble was the belt joint and the fastener, but this series of experiments did not cover that subject, and general accepted industrial values must be assumed. With regard to creep and coefficient of performance, those were entirely different factors. Creep could not be altered, but the coefficient of performance might be increased by applying dressings. In a rubber belt giving a 75 per cent. coefficient of performance, that figure had been increased to 90 per cent. by applying a dressing of oxidised castor oil. He found himself in agreement with Mr. Young with regard to the bogey of high tensional ratios.

Replying to Professor Charnock, Dr. Swift said that one of the great difficulties was that of obtaining quantitative results from indirect experiments. He thought that belts should be tested in actual operation. With regard to the use of a gravity idler on the tight side of a belt, the effect was to slacken and not to tighten it.

The Institute of Fuel.

No. I.

THE annual two days' Conference of the Institute of Fuel was held at the Institution of Electrical Engineers, London, on November 21st and 22nd. Lord Melchett opened the Conference on November 21st, and delivered an address, of which we give an abstract below. The remainder of the Conference will be briefly reported in out next issue.

PRESIDENTIAL ADDRESS.

The Right Hon. Lord Melchett, Founder President of the Institute, delivered the annual presidential address for the third year in succession. He intimated, however, that that would be the last occasion on which he would have the opportunity to deliver such an address, because Sir David Milne Watson had consented to accept the presidency. He assured the members, however, that he would do all he could to further the interests of the Institute in the future, particularly as he had flattered himself that he had had some share in its creation.

Dealing with certain broad aspects of the fuel and coal problem, he said that the fuel and coal industries of the country were unbalanced, and although good in some parts, were in bad condition in others. The first and the ugliest phase of the industrial revolution, he continued, had long since spent its main force. It was being followed by a second phase that was well on its way towards practical results. The old industrial view was giving way to a more rational conception of industry. He invited his hearers to contrast the present tendency of the coal industry in general with the position in which 3000 separate colliery companies each worked their pits according to their own lights, or the lack of them. It might be suggested that the Institute of Fuel, by continually attacking the problem of making 1 lb. of coal be burned where 2 lb. were burned before, was temporarily hindering the coal trade; but it was for its ultimate good. As an instance of the progress being made, he alluded to the ever-increasing pressures being attained in steam generating plant, and mentioned a set of boilers, recently installed at the new fertiliser factory at Billingham, which will work at a higher pressure than any in Britain at present. The drums of the boilers are 48ft. long, 4½ft. in diameter, and 4½in. thick. In conjunction with their generating sets, the boilers would produce power at a figure lower than that of any similar station in the world.

The problem with which the coal trade was faced was to tide over the present period of disorganisation and over-production in such a way that what might be called the legitimate output of coal when used with the utmost economy would satisfy the needs of the world. The formation of the Fuel and Power Committee, of which the Government had appointed him chairman, was an earnest of the awakening of the national conscience to the urgency and importance of fuel problems. Lord Melchett drew attention particularly to the Committee's advice to the coke oven industry that it should form a National Research Association, embracing the local research associations, and conducting organised research into coking problems. A central body, he said, was always in a better position for the conduct of research than a local one; there was always a tendency, and a very natural one, to regard research as a service, and it was found frequently that the research staff was possibly very effectively assisting day-to-day production, to the neglect of problems of a more distant but eventually more far-reaching importance. The plea for co-operation between large coal consumers in the exchange of technical experience as to its uses he also commended in the most cordial terms.

Among the many industrial developments which had resulted in economy of fuel, Lord Melchett mentioned the increased utilisation of water power, which had affected the coal trade of this country considerably. Countries which had no coal resources were now entering into the industrial race, and it was essential for us in this country so to improve our power plants that we could compete with countries using water power. He was assured by a competent expert that that could be done.

There was a great change in spirit in the world to-day. Formerly life was fairly simple: something was produced and the best price was obtained for it, and if a profit were made, one was quite happy. Nowadays, however, the suppliers of coal were supposed to know every trade in which the product was used, and every use to which it was applied. They were supposed to go to every householder, design a furnace to heat his house, teach the servant how to use it, and overcome the prejudices of his wife. They had also to persuade every coal merchant to be a very honourable man, who always was truthful and never overcharged. The suppliers of coal were supposed to go into the factories, examine every installation to persuade the engineer that he did not know his business, to persuade the purchasing agent that

he did not know how to buy, and to persuade the manager that he did not know how to run his business. Having done all that, the suppliers of coal, if they made a profit of 6d. per ton were regarded as profiteers. In addition, they must know the conditions of all the world's markets, and were expected to make a guess as to what the people in various parts of the world would use in the next five years.

Discussing further industrial developments, Lord Melchett said he had been told recently that one of the largest German steel works obtained its coke for nothing, because the price which could be obtained for the coke oven gas and other by-products covered the cost of the coal and the cost of its conversion into coke. It was obvious what a great economy that meant per ton of pig iron, and subsequently per ton of steel. If those with whom we were in daily competition could devise means by which such an important raw material as metallurgical coke could be obtained much more cheaply than we could now obtain it that was another great handicap to the revival of our steel industry.

Discussing unemployment, he said he was not convinced that the estimate of what was commonly assumed to be the permanent amount of unemployment in the coal industry—*i.e.*, of from 200,000 to 250,000 men—was correct. It was almost impossible, of course, to form a true estimate. It must be borne in mind that depression was not confined to the coal industry of this country, but affected the coal industries of other countries. The iron and steel, shipbuilding, and engineering industries had all been depressed, but it looked as though they were becoming somewhat brighter. There were many reasons for the post-war depression, as, for instance, the necessity for disposing of surplus stocks created during the war, the difficulties of the new economic conditions in the iron and steel industry, particularly at the time of the very low exchange values in France and Belgium, and the fact that many of our works were obsolete or obsolescence, needing concentration and re-modelling. Nobody could convince him that fundamentally any of those industries were moribund, or that there was any reason why they should not regain their previous position. With a general expansion of world trade, there would be a larger consumption of fuel, and even allowing for the economies of new machinery, we should be able at some future date to employ in the industry many more workers than some people imagined.

The coal situation, Lord Melchett continued, was a world problem. In the first weeks of the coal dispute he had made every endeavour to impress the importance of a rational organisation of the industry, particularly upon its selling side. He had taken the trouble to get into contact with big German interests in order to ascertain the methods by which they had worked so successfully for the last thirty years, so that our coalowners might be able to learn something. If more had been done at that time in the direction indicated, the dispute would have ended months before it actually did end, and the country would have been saved a large amount of money and lost business. In the last two years, however, a fair amount had been done in the direction he had indicated, but, unfortunately, it was not nearly enough. For instance, under the Amalgamated Anthracite Collieries, Ld., 80 per cent. of the total production of anthracite in this country had been merged. That affected only a small section of the whole coal industry. In most coal-producing districts various colliery companies had amalgamated, and the movement towards such amalgamations must be developed. More progress had been effected in the formation of coal-selling organisations. For example, the Five Counties Scheme was a great step forward, because the production of coal had to be brought into relation with the demand for that product. Headway had also been made in the coal-selling scheme for South Wales, and meetings were now being held with a view of organising a completely national scheme for the selling and distribution of coal. It was clear that no cure could be applied until a well-thought-out national scheme was adopted, with the necessary devolution into the coal-producing districts for immediate and detailed control. That provided one highway along which some amount of progress in coal production and some amount of relief for unemployment in the industry could be reached.

Discussing the technological side of the fuel industry to-day, he said one could not fail to be impressed by the large increase in the number of powdered fuel plants. It was usually supposed that the chief advantage of powdered fuel was that extremely low-grade fuel could be burned easily. In his view, one of its greatest attractions was the way in which powdered installations would rapidly accommodate themselves to varying calls. The most important point was that it provided an extraordinary intensity of combustion, and, consequently, a very high temperature was obtained. The importance of temperature in nearly everything could not be impressed too often upon the public mind. Powdered fuel was not only a development of the coal industry which was rapidly gaining public favour, but it had, in addition, the solid advantage of standing on a good theoretical basis.

Low-temperature carbonisation was another matter referred to by Lord Melchett, and he said he was interested to learn from Sir David Milne Watson that the plant being installed at the works of the Gas Light and Coke Company, at the request of the Government and in connection with the Fuel Research Department, was likely to come into operation at an early date.

After drawing attention to the importance of selling coal in a better classification, and to the need for standardisation in screening, he drew attention to the coal-cleaning method developed by Dr. R. Lessing, and now being operated by one of the companies with which he (Lord Melchett) was associated. The process depended upon the relative densities of the wanted and unwanted portions of coal in a suitable medium. The problem which at first sight might appear to present the greatest difficulty in connection with that process, namely that of freeing the coal from the liquid medium used, had been completely overcome. The process had now emerged from the experimental stage, and the coke made from coal cleaned in that way was of particularly high quality and contained very small quantities of ash. The process would no doubt have a considerable influence in popularising the use of semi-coke. Blast-furnace coke made from coal cleaned in that manner had also great possibilities, and the figures which had been given by Dr. Lessing proved that there was a possibility of effecting considerable savings in the cost of production of pig iron.

After a reference to the importance of an awakening of the national conscience on the subject of fuel economy, and to the recognition of the increasing importance of the combustion engineer, which recognition had been accompanied by increased attention to his training, he said he was proud to know that the Institute of Fuel had instituted a Fellowship which was intended to be a real mark of technical distinction in that most important branch of our national economy. He considered that the Institute had succeeded in framing a scheme in which not only academic qualifications, but also technical experience and achievement had their due weight.

Considering the present position of the coal industry with a view to discovering if there were lessons to be learned for the future, he said that the main factor in the re-establishment of the coal industry of this country on a sound economic basis was its internal reorganisation in technology, commercial directions, and labour relations, followed by Imperial and international reorganisation and agreement. Countries such as our own, which depended upon export to a considerable extent, would have to make an arrangement with other coal-producing countries. Internal reorganisation should take place promptly. In what other industry, he asked, would unproductive units, such as were seen in the coal trade the world over, be tolerated. On the technical side of the fuel industry there were great possibilities for the future. Our mining engineers were second to none, but were subjected to a great amount of totally unfair criticism. The best of our minds were in the first rank. The general fuel problem before this country was an extremely complicated one. We were frequently faced with the rival claims of gas and electricity, but there should be no such rivalry. The conversion of coal into oil would undoubtedly yield an economic solution in the next decade. Further, the problem of the direct employment of coal, as a complicated chemical substance, was as yet in its infancy.

Concluding, Lord Melchett said that he need not mention again the truism that any revival in the coal trade would have direct and immediate effects upon the general prosperity of industry and of the whole country. How was such a revival to be brought about? He had already suggested that technology, commercial reorganisation, and industrial co-operation were those directions in which the fateful course of British industry, and particularly the British coal industry, might again tread the path of progress and prosperity. Along those directions that revival in trade and commerce which the country and its population, employed and unemployed, so earnestly desired, and so wistfully looked for, might be achieved. In that achievement, in the successful inauguration of the second phase of the industrial revolution, there were few bodies which could render greater service than the Institute of Fuel.

Sixty Years Ago.

SEVERAL interesting points were raised in his opening address delivered on November 7th, 1868, before what was then the North of England Institute of Mining Engineers, by the incoming President, Mr. George Elliott. The address was printed, apparently in full, in our issue of November 20th of the same year. At that time the question of the duration of our coalfields was specially engaging public attention. A Royal Commission was investigating the subject, and Mr. Elliott was one of the Commissioners. While stating that he did not presume to anticipate the Report of the Commission, he said that he had no hesitation in expressing his (own) opinion that the duration of our coal supply depended, in great degree, upon the scientific improvements we were able to make in our mode of ventilating the workings. It was probable, he continued, that the ordinary means of ventilation—whether by furnace or fan—might be aided by a change in the force or agency employed for the purposes of haulage and other underground work. He had introduced in South Wales an apparatus in which compressed air was the motive power, which drew trams and pumped water, and which was found to generate ice in an atmosphere which was naturally hot and oppressive. That cooling property might, he thought, prove to be a valuable auxiliary to the more regular means of ventilation, and the difficulties of ventilation once surmounted, the extent of coal at our disposal was incalculably increased. . . . Turning then to quite another point, Mr. Elliott remarked that for more than a quarter of a century he had looked forward to being able to dispense with the use of gunpowder for winning coal. The use of gunpowder was, he said, the fruitful source of colliery accidents; once abolish it and the need for naked lights was gone. Safety lamps might be devised which the pitmen could not open; and the grave disasters, which it was one of the first duties of the Institution to guard against, would be diminished to an extent which it was impossible to look for then. Fortunately, engineers had come in with help. He had recently seen three appliances for getting coal mechanically, and his conviction was that mechanical means would very soon make the use of gunpowder unnecessary; that lights which it was possible to explode would, in consequence, be banished from our pits; and that coal would be produced in far better condition, as well as at comparatively little risk of life. . . . Mr. Elliott then passed on to make a proposal which, he said, he had very much at heart, and which, if given effect to, would, he thought, exercise a beneficial influence upon the rising generation of mining engineers. It was that an endeavour should be made to amalgamate with the other Mining Institutions of the country, so as to insure a more general recognition of the importance and usefulness of their calling. "With the advantages opened to us in the present day," he urged, "it is surely not too much to hope that this Association may join with its neighbours and assume a national title and character. The time is long past for our objects and aims to be even nominally limited to a province or to a district. The United Kingdom itself need not represent the limits from which the mining engineer may select, or the interests to which he is to look." He submitted, therefore, for the consideration of the Institute that it should look forward to its title taking a national rather than a provincial form, and to the time when the words "Great Britain and Ireland" might be substituted for "North of England" in its papers and documents. . . . It was an ambitious idea, but it was not realised. The words "North of England" remain; the only change made in the name of the Institute being the addition of the words "and mechanical."

The Institution of Civil Engineers.

OCTOBER EXAMINATIONS, 1928.—PASS LIST (*INTERIM*).*

(*Subject to confirmation by the Council.*)

PRELIMINARY (46).

R. I. Bataline, J. Beaumont, J. M. Bett, E. V. Bevan, T. H. Canning, W. F. Caton, G. C. Cole, C. C. G. Daniels, T. H. Davies, C. H. Deakin, M. R. Dharmasiriwardhane, T. G. Elliott, W. B. Fairless, C. M. Field, A. L. Fielding, J. M. Foxley, H. S. Graves, N. Greenshields, jun., S. Herson, G. Holden, W. T. Jeffries, S. Khan, C. Lofthouse, G. N. Maynard, H. Morton, H. G. Moulding, M. J. Page, J. C. Pridham, A. M. Rankin, H. W. Rispin, W. H. Roden, A. W. Rodmell, W. K. Rodwell, W. D. Sangwin, A. D. L. Shea, N. P. Simansky, C. F. R. Simpson, G. N. Simpson, A. E. Smith, K. E. Trask, F. W. Warren, R. W. Watts, R. A. Wheeler, S. K. Wibberley, J. S. Williams, G. F. Young.

ASSOCIATE MEMBERSHIP (165).

Whole Examination (Sections A, B, and C) (6).—G. Ashton, J. Y. Danks, J. Mulgrew, H. F. Sadek, F. C. Sage, W. G. P. Thorold.

Sections A and B only (8).—R. O. Atkinson, S. G. Barrett, T. G. Dewhurst, C. R. Hawkins, E. A. Kanso, H. G. King, H. J. Miller, F. R. Wright.

Sections A and C only (1).—W. C. N. Bosworth.

Sections B and C only (10).—G. R. Bennett, H. Duckworth, C. S. Gray, S. C. Hardern, J. H. Murray, A. N. Peters, A. Saleh, P. G. W. Stokes, F. E. Turner, L. F. Weldon.

Section A only (24).—R. F. Alexander, H. J. W. Buick, G. Butters, T. V. Cuerden, H. J. Eddie, G. C. N. Elliot, F. Everitt, A. S. Fairn, T. L. Farnes, B. W. Hadfield, C. C. B. Herbert, L. S. Layman, J. E. Lee, G. A. Lewis-Bowen, J. W. Mills, A. J. P. Pashler, J. H. A. Perkins, E. W. E. Simpson, F. K. Sinclair, J. N. Smith, S. P. Squire, W. Tivendale, W. H. Vickers, K. Wahba.

Section B only (26).—H. G. Andrews, H. R. Anstee, C. H. Bunclark, W. F. Cartwright, G. H. Clegg, K. H. B. Collier, A. G. Copsey, E. G. Dale, A. R. Dippie, G. G. Gwilliam, N. B. Hodgkin, J. D. How, V. Johnson, G. R. Kettlewell, J. McC. Lee, R. E. McCreadie, F. Morgan, W. J. Scott, F. B. Smith, W. J. Smith, L. G. Snow, W. S. Stredwick, H. E. G. Stripp, E. E. Sweeting, G. M. Vibart, G. E. Walker.

Section C only (90).—W. E. L. Adams, A. Aitken, G. T. Allcock, W. G. M. Anderson, C. G. Angold, B.Sc. Eng. (Lond.), A. M. Azmy, H. C. Barrett, F. L. Barrow, B.Sc. (Birmingham), G. J. le B. Beaumont, A. Begleman, N. B. Bennett, C. V. Berry, B.Sc. Eng. (Lond.), F. H. Blake, B.Sc. Eng. (Lond.), C. V. Blumfield, B.Sc. Eng. (Lond.), E. G. Brentnall, B.Eng. (Sheffield), D. V. Buck, H. P. Budgen, B.Sc. (Birmingham), H. W. Cameron, J. Carr, B.Sc. Eng. (Lond.), D. H. Cassidy, B.A.I. (Dublin), G. L. Cassidy, G. B. H. Cave, B.Sc. (Bristol), H. F. Commerford, H. S. Cotterill, B.Sc. Eng. (Lond.), B. W. Davies, H. H. Dixon, B.A. (Oxon.), J. Dossor, H. C. E. Dunn, W. G. Dunstan, R. Elliott, J. Fairweather, B.Sc. (St. Andrews), P. B. Fasham, J. W. S. Fawcett, S. Feather, W. E. Fecher, R. T. Fitzpatrick, B.Sc. (Manchester), R. E. Fortune, B.Sc. Eng. (Lond.), J. G. Gardiner, C. R. Glover, B.Sc. Eng. (Lond.), F. H. Greenhough, G. L. Gundry, H. R. Haldane, B.Sc. (Glas.), C. H. Hales, W. B. Hardy, B.Sc. Eng. (Lond.), C. G. Havers, B.Sc. Eng. (Lond.), F. Hewson, J. Izatt, L. Jefferies, S. A. Jordan, B.A.I. (Dublin), C. C. Judson, B.Sc. Eng. (Lond.), D. D. Kails, E. T. Kaye, B.Sc. (Manchester), R. H. Kirkpatrick, B.Sc. (Belfast), J. Kitching, B.Sc. (Edin.), G. C. Law, W. M. Law, G. H. F. Lutter, J. MacF. MacAlpine, C. W. N. McGowan, B.A. (Cantab.), J. L. Macmorran, G. J. Mair, D. W. E. Meegama, B.Sc. (Glas.), C. H. Netherton, B.Sc. Eng. (Lond.), J. A. Nichols, R. N. Pegg, C. H. Peppiatt, B.Sc. Eng. (Lond.), R. R. H. Rains, B.Sc. Eng. (Lond.), A. G. Richardson, J. Robertson, B.Sc. (Glas.), J. S. Robertson, F. C. Sabin, B.Sc. Eng. (Lond.), D. S. Samuel, W. B. Shannon, C. P. Shelbourne, M. Shneerson, A. F. Smith, B.Sc. Eng. (Lond.), S. G. Squires, M. Stern, B.Sc. Eng. (Lond.), H. G. P. Taylor, B.Sc. Eng. (Lond.), G. Thomson, B.Sc. Eng. (Lond.), A. A. Torrance, B.Eng. (Liverpool), F. Unwin, S. E. Van Ryssen, C. E. H. Verity, P. F. S. Warren, B.A. (Cantab.), D. J. Watkins B.Sc. Eng. (Lond.), N. D. Watson, B.Sc. (Belfast), L. Wettern, B.Sc. Eng. (Lond.), J. H. H. Wilkes, B.Sc. Eng. (Lond.), R. Wyllie.

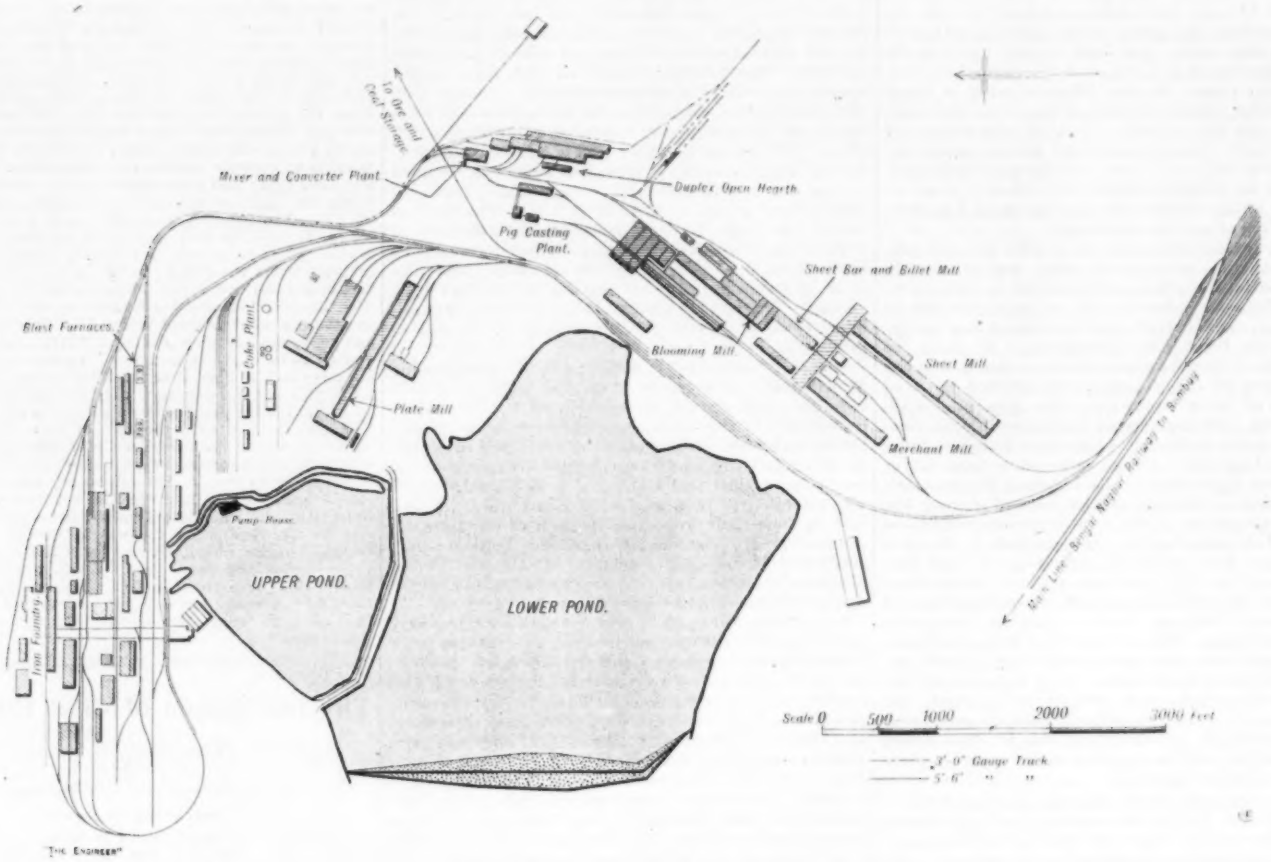
* The results of the examinations held abroad will be given later.

The Jamshedpur Iron and Steel Works.

THE Jamshedpur Iron and Steel Works, which are the property of the Tata Iron and Steel Company, Ltd., are situated at the junction of the rivers Khorkai and Subarnareka, 150 miles or so to the westward of Calcutta. They were founded by the late Mr. Jamsetji Tata, a distinguished Parsee gentleman, to whom is attributable much of the recent industrial progress of India, and their construction was begun in 1907, though they were not actually in commercial operation till some five years later. Their site was carefully chosen, in view of the accessibility of raw materials and other considerations. The works lie approximately 100 miles from coalfields, 40 miles from iron ore, and 100 miles from deposits of dolomite, but there are no sources of limestone within easy distance of the works. Large quantities of high-grade iron ore are available. One source is an extensive field, largely magnetic, carrying 69·0 per cent. of metallic iron and 0·01 per cent. of phosphorus. Another large source, which is controlled by the company, was originally estimated to contain 7½ million tons of ore containing from 60 to 63 per cent. metallic iron and 0·10 per cent. of phosphorus. This deposit, together with others in the district, is now estimated to contain 39,400,000 tons of non-titaniferous ores, containing between 60 and 70 per cent. of metallic iron. There is also ample manganese for the requirements of a very large steel industry. Furthermore, the company has acquired several colliery properties, in which there are no serious mining difficulties in winning the coal, saving that in some of them large quantities of water have to be handled during the rainy season. Mechanical coal cutters are being successfully employed in these mines. As a still further advantage, the company is associated with the Kumardubi Fire Brick Works at Chota Nagpur, and the fire bricks made from clays found in the Jherria coalfield are entirely satisfactory. We understand that one of the 600-ton blast-furnaces at the works has produced upwards of a million tons with one lining of these bricks. Finally, the river Subarnareka has never been known to run dry, even in the hottest summers; the climate is healthy and dry; the works stand at an elevation of some 550ft. above sea level; and though the temperature reaches 118 deg. Fah. in the shade during the hot season, the heat is not unbearable.

The company when it was originally formed had a capital of £1,545,000, but it has always pursued a progressive policy, making frequent extensions to its equipment, and modernising its plant as opportunity offered, and it now has a capital of over eleven millions sterling. Its two original blast-furnaces each had a 12ft. hearth and were each 77ft. high and had eight tuyeres. Each had a capacity of 200 tons of pig iron per day, and they were blown in in November, 1911, and September, 1912, respectively. Each is furnished with up-to-date charging apparatus and four Cowper-Kennedy stoves. The hearths of these two furnaces were, later, enlarged to 14ft. 8in. diameter, so that they were capable of an output of from 300 to 350 tons of pig iron per day, and now one of them is being rebuilt with a 21ft. hearth. During the war, the shortage of ferro-manganese in India led to the rapid erection of a similar 12ft. hearth furnace, that dimension being subsequently enlarged to 14ft. 8in. Later additions are two furnaces of the most modern type, 90ft. high, and with hearths 17ft. in diameter. These furnaces have, each of them, a nominal daily capacity of 600 tons of pig iron, and one of them recently made a record with a production of 847 tons in twenty-four hours. One of the 17ft. hearth furnaces has now been enlarged to 19ft. 1in. With the largest furnace, a production very nearly approaching, if not actually reaching, 1 ton per minute is confidently anticipated.

The original coke-making plant comprised 180 Coppée non-recovery ovens, but that plant has since been discarded. To it were added a battery of fifty Koppers by-product ovens and a Simon-Carves

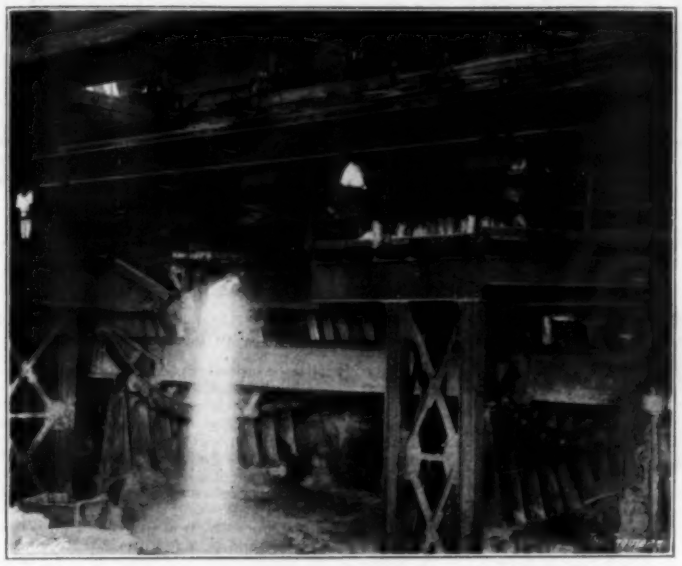


PLAN OF THE JAMSHEDPUR WORKS

OPEN HEARTH PLANT, TEEMING STEEL INTO INGOT MOULDS

DUPLEX PLANT, TILTING FURNACES

sulphuric acid plant, which supplies the acid necessary for the production of sulphate of ammonia. Subsequently, three batteries, each consisting of fifty 11-ton ovens of the Wilputte design, were added, and now a fourth battery is being installed and extensions are being made to the coal tar and ammonium sulphate and benzole recovery plants. In this connection it is worthy of note that all the silica shapes required for the construction of these new ovens were made at the works of the Kumardubi Brick Company.



DUPLEX PLANT. TILTING FURNACE AFTER POURING A LADLE

OPEN HEARTH PLANT. LIFTING INGOT FROM SOAKING PIT

The steel works plant now consists of :—

(*a*) One 300-ton mixer.

(*b*) Seven open-hearth furnaces, five of which have capacities of from 55 to 65 tons per heat, while two are of 100 tons capacity ;

(*c*) Two 25-ton Bessemer converters ;

(*d*) Two 200-ton duplex tilting open-hearth furnaces ; and

(*e*) One 1300-ton mixer, which is one of the largest in the world.

In addition, provision has been made for a third converter, and a third duplex tilting open-hearth furnace, which is now being constructed.

In the older part of the works there are four soaking pits, capable of receiving ingots weighing from 65 cwt. to 105 cwt. each, and equipped with electric overhead charging and drawing cranes.

In this part of the works, too, there is a 40in. blooming mill, which is operated by a 11,000 H.P. Galloway engine. In a newer part of the works there is a further 40in. two-high blooming mill, which is of the reversing type and is motor operated. It is equipped with an hydraulic manipulator, and is followed by hydraulic shears. This blooming mill is driven by a motor, which is rated at 5600 H.P., but is capable of taking a peak load of 22,000 H.P.

Another mill in the older portion of the works is a 28in. finishing mill, which has three sets of rolls, and is driven by a 12,000 H.P. engine. It is capable of producing (*a*) rails weighing from 30 lb. to 100 lb. per yard ; (*b*) joists from 5in. by 3in. up to 15in. by 6in.; (*c*) angles from 3in. by 3in. up to 6in. by 6in.; and (*d*) channels from 6in. by 3in. up to 12in. by 4in. There is also a 16in. bar mill for making light rails, and two 10in. mills which are devoted to the production of the lighter sizes of flats, squares, and rounds.

In the newer extensions to the works, the motor-driven blooming mill serves a new 28in.–30in. rail and structural mill. This new mill is three-high and in three stands, the roughing or first, and the intermediate rolls being on the same shaft, which is driven by a 6300 H.P. motor that is capable of exerting 15,500 H.P. The finishing stand is driven by a 1400–2800 H.P. motor. There are, working in conjunction with this mill, four drop hot saws, which, operating simultaneously, cut the rails into three pieces.

There is a new bar mill of the latest Morgan continuous type, which takes billets from the sheet bar and billet mill. Independent motor-driven rolls are added for the production of wire rods. A tandem plate mill, which is driven by one 2000 H.P. and one 2500 H.P. motors, taking alternating current at 3000 volts, operates in conjunction with four bottom-type reheating furnaces. It produces plates varying in thickness from ¼in. to 1½in., in various widths up to 84in. and in lengths up to 50ft.

A new sheet bar and billet mill is arranged in direct line with the new blooming mill. It is of the latest continuous type, and rolls billets from 6½in. square downwards to 1½in. square for the bar mills. It also rolls sheet bars up to 8in. wide for the sheet mill. Steel sleeper sections up to 16in. wide are also finished in this mill. From this mill, too, bars are delivered to the sheet mill proper, where there are six reheating furnaces. The rolling equipment comprises two jump rolls, two balanced rolls, six finishing mills, and two cold rolling mills, all driven by a 1500 horse-power motor operating on 3000 volts alternating current. This mill produces sheets in widths up to 38in. and of any desired thickness from ⅛in. down to 0·01in.

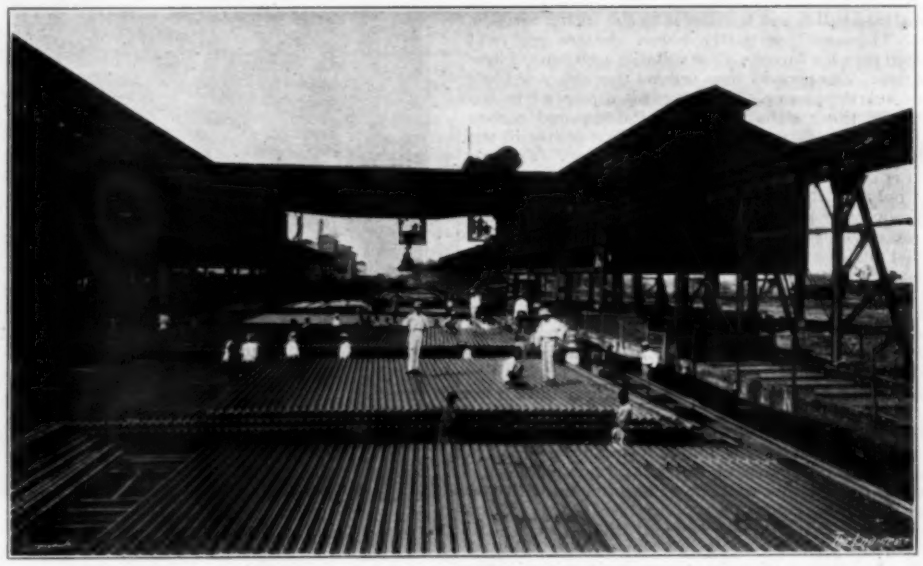
The original power-house contains one 1000-kW, one 1500-kW, one 4000-kW, and one 5000-kW turbo-generators. In addition, there are two turbo-blowers, each with a blowing capacity of 40,000 cubic feet per minute, one with a capacity of 35,000 cubic feet, and one with a capacity of 30,000 cubic feet. The boiler plants comprise several batteries of Babcock and Wilcox boilers—some gas fired—and waste heat boilers, while ten 1000 horse-power John Thompson water-tube boilers are now in course of delivery to replace twenty 500 horse-power Wickes boilers.

The second power-house, which supplies power to all the new extensions, contains one 5000-kW and two 10,000-kW turbo-generators, while a further machine of 18,000 kW capacity has recently been shipped from Europe and is now being installed. There are, at the present time, one 37,500 cubic feet and three 45,000 cubic feet turbo-blowers, while two new 65,000 cubic feet blowers are now being built to take the place of the three 45,000 cubic feet blowers. It is also proposed to install two new blowers, each with a capacity of 75,000 cubic feet against 25 lb. per square inch pressure.

In the early part of the company's history the staff was composed of a few Americans for the blast-furnaces, Englishmen for the rolling mills, and Germans for the open-hearth department. At the outbreak of the war it was necessary to remove the Germans, who were interned for the duration of hostilities, their places being taken by men taken out from Middlesbrough. At the moment of writing the works are temporarily closed owing to industrial troubles, but just previously the staff comprised 145 Europeans and Americans and about 40,000 Indians, some 10 per cent. of the latter being women. The women of the locality are, generally, physically superior to the men, and they are employed for all kinds of general labouring, particularly that of transporting material, which they carry in small baskets on their heads.

Recently a booklet on the "Production and Inspecting of Rails" at these works was issued as one of the official publications of the Indian Stores Department of the Government of India. It was written by Mr. E. A. Wraight, A.R.S.M., M.I.M.M., F.I.C., who is Government Metallurgical Inspector at the works. From this booklet we quote, in what follows, particulars concerning the various processes and operations, and of the searching tests which the rails have to undergo.

It is explained that the basic open-hearth process as worked at Jamshedpur consists in charging a mixture of ore, lime, and scrap steel—crop ends of billets, rails, structural material, &c.—into the furnace, and when it is melted "flat" adding molten low-silicon pig from the mixer. During the ensuing reaction or "boil" a certain amount of carbon and manganese is oxidised and removed, as are also the bulk of the silicon, possibly some of the sulphur, and the greater portion of the phosphorus present in the charge.



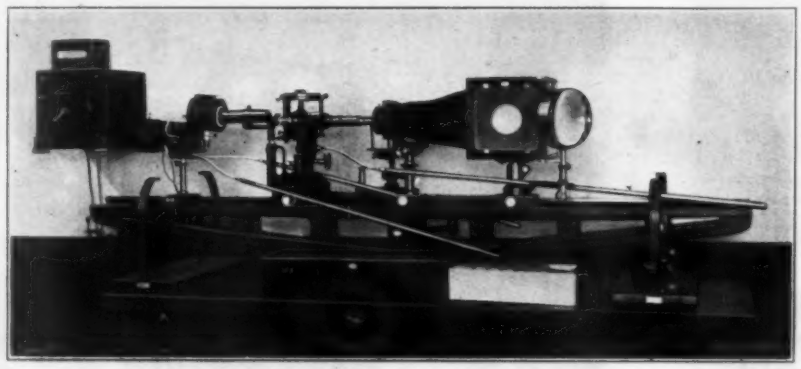
A SECTION OF THE RAIL INSPECTION BANK

When the "boil" has subsided and the flow of the "flushing" slag from the furnace has ceased a gradual oxidation of the remaining carbon, manganese and any residual silicon and phosphorus takes place. Samples are taken from time to time, and when the "sample passer" judges that the carbon content is approximately correct and that the metal is at a sufficiently high temperature, ferro-manganese is charged into the furnace, which is shortly afterwards tapped. During the passage of the molten steel into the ladle ferro-silicon is thrown into the stream of metal, together with coke additions, if necessary, in order to bring the carbon of the steel to the required specification.

When all the steel and a little of the slag from the furnace have entered the ladle the latter is allowed to

remain stationary for a few minutes. It is then lifted by a crane and the liquid steel is teemed into ingot moulds containing approximately 65 cwt. or 105 cwt. of metal, those being the only sizes of moulds at present in use. The moulds are made of pig iron cast in the works and are "reeked" or coated internally with tar and graphite.

During the teeming of the "heat" a ladle sample of a few pounds is taken by means of a spoon held under the nozzle of the ladle. This sample is poured into a small mould and subsequently forged. Three samples are taken at different periods of the teeming, usually at the second, tenth and fourteenth ingots of the cast. A portion of the middle sample is taken to the Government Laboratory for analysis, together



PHOTOMICROGRAPHIC APPARATUS

with the results obtained by the company's analysers of all the three ladle samples.

In the duplex process as carried out at the Jamshedpur works the silicon, manganese, and, to a certain extent, the carbon are eliminated by blowing air through molten pig in an acid-lined Bessemer converter. The metal is then transferred to a tilting open-hearth furnace, where the phosphorus is removed by means of lime and the carbon reduced to the correct percentage by ore additions in the usual manner. The duplex plant comprises a mixer, two acid-lined converters, each of 25 tons capacity—the lining being an acid rock, micaceous quartz, mined locally—and two tilting furnaces, each of 200 tons capacity, together with the usual accessories, gas producers, &c.

The mixer, as has been said above, has a rated capacity of 1300 tons, but it is rarely worked at full load. Molten pig from the blast-furnace is transferred to the mixer and a regular supply of metal of uniform composition is thus ensured for the converters.

The usual method of working a heat for rail steel is to blow three charges of from 20 to 25 tons each down to a very low carbon content, pour the dead-blown metal into ladles and transfer it to the tilting furnace. Two "kickers" or partly blown charges are next poured into the furnace after suitable additions of lime and ore. The process then follows the ordinary basic open-hearth practice. Phosphorus is eliminated by the lime and the bath is worked to the required carbon content, ferro-manganese added—often partly in the ladle—and the furnace tapped by tilting. The tap hole is normally above the level of the molten metal and only lightly closed. The contents of the furnace are wholly or partially received in a 100-ton ladle—which actually holds up to 125 tons—ferro-silicon is added and the metal teemed as previously described.

Mr. Wraight then goes on to state that each of the eight soaking pits is provided with regenerators—for air heating—and is subdivided into four compartments, each of which is capable of holding four ingots. These compartments measure 8ft. by 6ft. by 9ft. 3in. and they are constructed mainly of silica brick. The sides are partly lined with chrome brick, and at the bottom is a bed of coke 18in. deep. This coke bed acts as a slag absorber and to some extent it assists in the maintenance of a non-oxidising atmosphere in the pits. The covers of the pits are movable and slightly arched, and each cover is provided with two sighting holes. Hydraulic power is used to remove and replace the covers which run on rails laid over the tops of the pits.

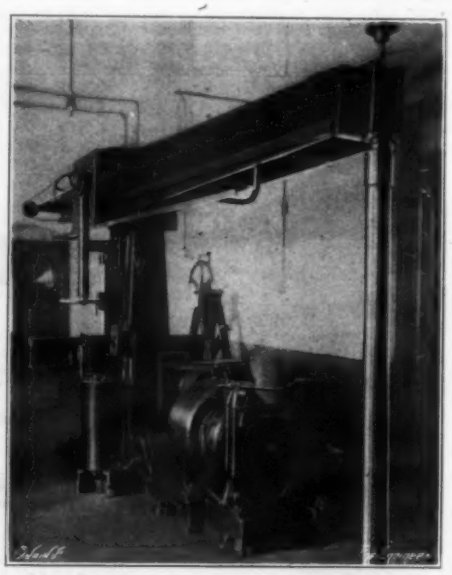
In the rolling of rails—those dealt with in the booklet are of the flat-bottomed type—a 30in. by 22in. ingot is first reduced to an 8in. square section in from twenty-two to twenty-eight backward and forward passes in the blooming mill, the bloom produced being from 45ft. to 55ft. in length. After sufficient crop has been sheared off to eliminate all pipe, the bloom is then sheared into three lengths, from each of which three rails are rolled.

During the rolling of rails pieces are cut at frequent intervals and examined in order to see if the section is correct. Should any fault be found the mill is immediately stopped and the error rectified. In addition, every hour a 2in. length is cut, allowed to cool, and tested by fastening the flange in grips and hammering the side of the head. This test indicates the presence of any flaw at the junction of the web and foot. Rail sections are also "pickled" in acid at frequent intervals during rolling to discover any possible flaws.

From each cast one piece of rail is cut and sent to the Metallurgical Inspector's office for any analysis that may be necessary. From the top bloom of the first ingot from each cast a piece is cut for the drop test. These tests are effected each morning from the casts made during the previous day. After testing each piece is drilled and the drillings are analysed.

The finished rails are spread horizontally in tiers of from 100 to 120 rails on inspection benches. They are first inspected by the company's officials, who reject any that they may consider unsuitable, and the remainder are then submitted to the Metallurgical Inspector. The accuracy of the drilling of the bolt holes is first tested, gauges being applied to a percentage of the rails at each end. Both ends of every rail are next examined for pipe or other visible defect. If the drilling of any rail is found to be inaccurate, or if any signs of pipe observed, the rail may be converted into a "cut-bar," *i.e.*, cut to a shorter length, replaned, drilled, and again submitted for inspection.

The rails which have so far passed muster are then "walked," one side of the web being first inspected. When that has been done the rails are turned with their heads upwards, and the heads and flanges are carefully examined, the whole rail being "viewed" for straightness from each side of the tier. Any bent or twisted rails are marked and returned for re-straightening and re-inspection. Then the rails are again turned so that the other side of the web may be examined, and finally they are turned foot uppermost and the bottom faces inspected. On the completion of this procedure the lengths of a percentage of the



50-TON BUCKTON TESTING MACHINE

rails are checked and the final stage comprises the checking of the section and "fishing" of the rails and a last examination for straightness.

From approximately each 100 tons of rails submitted for inspection one piece is selected for complete analysis. The accepted rails are held in stock till all the analyses are completed. Each cast of rails is finally judged on the results of analysis, combined with the drop test results.

In the event of failure under the drop test, which, Mr. Wraight points out, is very rare, all the rails from that particular cast are broken up and re-melted or sold as scrap.

The procedure outlined in the foregoing is effected on all rails weighing 30 lb. per yard and upwards. Rails of smaller section are not inspected so rigidly. The limits of chemical composition and the tolerances allowed by the specification being worked to are strictly enforced and no rail is shipped which is in any way defective. Special attention, it may be added, is paid to rails intended for points and crossings, both with regard to physical conditions and chemical composition. Such rails have to stand two blows under the drop test and to conform to certain narrow limits on chemical analysis. As can be readily understood, the equipment of the laboratories at this works is of a high-class character. Two of our illustrations represent a 50-ton Buckton testing machine and a photomicrographic set, respectively. Both of these are in the Metallurgical Inspectorate.

We are enabled to give herewith and on page 576 reproductions of a series of photographs which have been sent, at our request, from India. The various engravings speak for themselves and do not require any detailed description. We have also to acknowledge our indebtedness to Tata, Ltd., of London, for courteous assistance during the preparation of this article, and especially to Mr. H. M. Surtees Tuckwell, one of the directors of that company, from a paper by whose pen much of the information in our article was obtained.

B.E.S.A. SPECIFICATIONS.

THE ELECTRICAL PERFORMANCE OF TRANSFORMERS FOR X-RAY PURPOSES (No. 326, 1928).

THIS new British Standard Specification is the first to be issued dealing with X-Ray apparatus. It applies to the main high-tension transformers of X-Ray installations, the subject being dealt with along lines very similar to the British Standard Specification for the electrical performance of transformers for power and lighting. In view of the special requirements, however, of X-Ray transformers, to meet the service conditions associated with X-Ray work, this new specification differs from the specification for power transformers in a number of important particulars. The most important feature is the definition of the rating of the transformer, this being in terms of the R.M.S. milli-ampère output when the rated peak voltage is being produced across the terminals. The usual method of expressing the output of a transformer in kVA is thus departed from, the reason being that the intensity of the X-Ray output is dependent upon the peak voltage rather than the R.M.S. voltage. The R.M.S. value of the current output is retained, however, as it is this value which determines the internal heating.

In addition to the rating, the specification deals with the types of cooling, standard sizes, primary voltage, regulation, &c., limits of temperature rise, and the quality of the insulating oil. The tests to be applied to the transformer are also included, one of which, viz., the switching test, is of special importance in the case of X-Ray transformers. The method of testing the output of X-ray transformers is given special attention, and the specification concludes with some notes on rectification, these notes emphasising the fact that the type of rectification employed determines the maximum tube current that can safely be obtained without exceeding the maximum output of the transformer. Copies of this specification, No. 326, 1928, may be obtained from the Publications Department, 28, Victoria-street, S.W. 1, price 2s. 2d. post free.

THE INSTITUTION OF CHEMICAL ENGINEERS.

THE completed arrangements for the Conference on Drying to be held by the Institution of Chemical Engineers are now announced. The Conference will be held in the Chemical Society's Rooms, Burlington House, London, W. 1, on Thursday and Friday, December 6th and 7th. Sessions will open at 10.30 a.m. and at 2.30 p.m. on each day.

On Thursday morning papers on "The Seasoning or Drying of Timber," by S. T. C. Stillwell, of the Forest Products Research Laboratory, and "Tunnel and Stove Drying," by A. T. Henly, will be taken. In the afternoon papers will be read on "Film and Spray Drying," by J. Arthur Reavell, and "Drying by Pressure," by Professor J. W. Hinchley.

On Friday morning Mr. T. J. Horgan will present a paper on "Rotary Dryers," and Mr. G. W. Riley one on "Vacuum Drying." The Conference will conclude on Friday afternoon with papers on "The Hygroscopic Nature of Textile Fibres," by Dr. S. G. Barker, Director of the British Research Association for the Woollen and Worsted Industries; "The Drying of Agricultural Products," by Captain B. J. Owen, of the Institute of Agricultural Engineering; and "Some Drying Problems in Tropical Africa," by A. Chapman Barnes, of the Department of Agriculture, Zanzibar. A programme giving the full particulars may be obtained from the honorary secretary of the Institution, Abbey House, Westminster, London, S.W. 1.

THERE are various ways by which signalmen at junctions are advised from the rear of the direction—to A or to B—in which approaching trains have to be turned, and, further, block signalled. When such advices are sent from a point some distance away, and when, therefore, there may be other trains to be dealt with, a record must at once be made in the train-register and reliance placed on the memory. But now that there are so many lines which are protected by automatic signals, there may be six or eight trains between two signal-boxes, and the man in the advance cabin is severely tested to remember the direction in which each train has to be moved. That is a question which was discussed at the Institution of Railway Signal Engineers on November 14th, when Mr. W. Challis, of the Southern Railway, said that he wanted a train describer which would provide for fifty sections and cover twenty-four classes of trains.

Railway Matters.

As it is generally agreed that the gale of November 15th and 16th was the worst for very many years, and caused considerable interruption in the cross-Channel services, it may be noted that the "Worthing"—the new boat on the Newhaven–Dieppe service of the Southern Railway and French State Railway—made a very good crossing to Newhaven on the 15th and returned to Dieppe the following day in 3 hours 12 min., which was only 27 min. over the time allowed.

SPEAKING on November 16th on the proposal to delete the London Traffic Act from the Expiring Laws Continuance Bill, Colonel Ashley said, in reference to Charing Cross Bridge, that very active negotiations were going on between the London County Council, the Southern Railway, and the Ministry of Transport. It had been said that that was not a very far advance; but when the stage of active negotiation and conference was reached, they had gone a considerable way towards the final solution of that great problem.

THE Ministry of Transport inquiry into the Charfield disaster of October 13th was resumed and concluded by Colonel Sir John Pringle on Friday, November 16th. When the signalman at Wickwar—the box next in advance of Charfield—was giving evidence, the representative of the Associated Society of Locomotive Engineers and Firemen, who was watching the interests of the driver of the mail—now under a charge of manslaughter—objected to the Press being present whilst that evidence was given, and the reporters thereupon withdrew.

IN the *London Gazette* of November 13th appears the following announcement:—"*Engineer and Railway Staff Corps.*—Major G. S. Szlumper, C.B.E., P.D., A.M. Inst. C.E., to be Lieut.-Colonel." Colonel Szlumper is the son of Mr. A. W. Szlumper, the late chief engineer, and now the consulting engineer to the Southern Railway. An ardent territorial he found his *métier* when, after some years in the engineering department and then in the general manager's office of the London and South-Western Railway, he became, before the outbreak of war, the secretary to the Railway Executive Committee. Later he was made docks and marine manager, with his office at Southampton, and, soon after the formation of the Southern Railway, returned to Waterloo as the assistant general manager.

THE recent gales remind one that the most serious railway accidents, next to the failure of the Tay Bridge on December 28th, 1879, arising out of severe wind, were those at Desford on the Midland Railway, on October 22nd, 1881, and Chelford, London and North-Western, on December 22nd, 1894. The latter was indirectly caused by a wagon being blown out of a siding and fourteen passengers were killed. At Desford a junction home signal was blown down on October 14th, and, as sixty or seventy other signals were down on the system, had not been replaced. A goods train had entered a loop line and the signalman failed to restore the points. Owing to the absence of the signal the omission was not detected, and a following passenger train was turned into the loop and collided with the goods train. Four passengers were killed. As a result of that accident the standard rules were soon afterwards altered to read, "When any fixed signal is out of order, but the interlocking of the point and signal levers is in proper order, the signalman must, to enable him to obtain the security of the interlocking, use the lever applicable to such signal as if the signal were in work."

THE Ministry of Transport railway statistics for August have recently been issued as a Stationery Office publication, price 3s. 6d. As was noted when the July figures were given in this column on October 19th, a comparison with the corresponding figures for August, 1927, is affected by the fact that Bank Holiday in that year was on August 1st, and a good deal of the holiday traffic was carried in July; this year the holiday was on August 6th, and conditions were therefore normal. The number of passenger journeys in August, 1928, was 2·3 per cent. higher than in 1927, but that was entirely due to an increase of 17·9 per cent. in those carried at reduced rates; those at full fare fell by 9·2 per cent. The former brought in 25·4 more receipts, whilst the latter led to a drop of 8·9 per cent. in the receipts from ordinary fares, and the net result was a decrease of 7·1 per cent. in passenger receipts. The tonnage of freight traffic was reduced by 6·4 per cent., equally contributed to by general merchandise, minerals, and coal and coke, and there was a fall of 6·8 per cent. in the freight train receipts. Passenger train mileage increased by 4·3 per cent., whilst freight train mileage was reduced by 4·4 per cent.

FROM the report for 1926–27 of the Indian Railway Board, it appears that during the year in question a decision as to building wagons, of no little moment, was arrived at. Such improvements have of recent years been made in the greater use of wagons that it became clear to the Railway Board that fewer wagons than before would be required to carry a similar volume of traffic efficiently and expeditiously. It, therefore, agreed with the railway administrations an average figure of the net ton-miles per wagon-day, which it would be reasonable to expect each railway to attain. It was then decided that until the actual wagon-user figure approached the agreed figure, no increase to the general service wagon stock of that railway was warranted. The formula thus arrived at showed that none of the broad-gauge railways required any additional general service wagons in 1927–28 or, indeed, in 1928–29, and, further, that on most broad-gauge railways it would be possible to scrap, without replacement, worn-out or obsolete general service wagons, which in other circumstances would have been renewed. The Board, therefore, decided that it would not be justified in placing any orders for broad-gauge general service wagons for delivery in 1927–28. The report proceeds to observe that it was obvious that that decision would cause considerable inconvenience to the wagon-building industry in India, and the question was, therefore, discussed more than once with representatives of the trade. Certain offers were made and, alternatively, the purchase of their works was proposed. As a result, the works of the Peninsula Locomotive Company were taken over, as recorded in this column on March 2nd, 1928.

Notes and Memoranda.

IN the report on the activities of the Royal Canadian Mounted Police, in the Eastern Arctic district, during last winter, it is stated that the police posts received instructions from Ottawa by radio, and reception varied considerably. At Bache Peninsula, within 700 miles of the North Pole, it was fair; at Dundas Harbour and Pond Inlet, 400 miles further south, it was good; and at Pangnirtung, another 400 miles southward, it was on the whole poor. The three places have almost the same longitude as Ottawa.

THE Underground Railway Companies announce that experiments with various types of ticket-issuing machines of both English and foreign makes have been proceeding for some time. The most desirable type of machine having been determined, tenders were invited for 143 machines. As there were no English tenders, the order was given to the A.E.G. Company, of Berlin. These machines, which will shortly be in general use on the Underground, print and issue a ticket while the passenger waits. It was impossible to secure the machines in this country. The Underground companies, it is stated, always buy their equipment and supplies in this country, on principle, so long as their requirements can be met, purchases abroad being rare.

ACCORDING to a statement made by Mr. W. M. Mitchell to the American Society for Steel Treatment, the low-nickel iron alloys—*e.g.*, nickel 8, chromium 18 per cent.—show good resistance to attack by a wide range of grades and concentrations of nitric acid. This fact is of considerable importance in view of the fact that the chromium-iron alloys containing nickel have welding qualities very much superior to those of the plain stainless irons. For this reason and also on account of their high degree of toughness, alloys of the 18 chromium, 8 nickel type are preferred for acid shipping drums and other parts which must be constructed by welding. The remarkable ductility of the nickel-bearing alloys also makes them very suitable for the manufacture of tubing for heat exchangers, &c., in nitric acid and other plant. These alloys also have good welding properties.

IN considering the use of molasses as a binding agent for core sand in foundry work, a writer in the *Chemical Trade Journal* says: "The only outstanding instance where the presence of molasses would adversely affect the metal—cast iron—is where an iron of high silicon content is being cast. This iron, after absorbing the carbon, would convert it to the graphitic state and consequently soften the metal, which is a serious matter with most cast irons. Brasses, gun-metals and most ordinary alloys return as good castings with molasses bound cores as with others, and are much more economically prepared. Nickel alloys on the whole return pretty much the same results as cast iron. The molasses comes from the sugar refineries in barrels and the composition on testing is often very variable. So long as it possesses the property of binding the sand in the required manner it suits the purpose and no further tests are required."

THE Swedish Government Department of Telegraphs and Telephones this month celebrates the seventy-fifth anniversary of its existence. The first telegraph line, that between Stockholm and Upsala, was opened in 1853. Within ten years all the more important lines connecting the different parts of the country were established, and at the end of the first twenty-five years the telegraph lines had a total length of 20,000 kilomes., and the length at the present time is about 45,000 kilomes. As early as 1873 the telegraph connections with Norway, Finland, Denmark, Germany and Great Britain were in use. The Government telephone system of Sweden dates its existence from 1881, when the first lines were opened in Stockholm. In 1928 the telephone department had 450,000 paying subscribers and transmitted about 717 million telephone calls. Sweden is now one of the leading countries in the world as regards the number of telephones per head of population and as to the proportional extent of its telephone service.

REPORTING concerning continental power stations running on pulverised fuel and visited by him recently, Mr. G. H. Lake, chief electrical engineer of Derby, says that high-pressure plants are now in fairly general use throughout Germany. A boiler at the works of A. Borsig is operating at 900 lb. per square inch, the Benson boiler at Siemens-Schuckert's is operating at 3375 lb., fired on the "Lopulco" system, sixteen boilers at the Klingenberg power station are operating at 500 lb., boilers at the Ieuna works are working at 675 lb. pressure, at a works at Oppau the boiler pressure is 630 lb., and at the electricity works at Mannheim vertical tube boilers are operating at 1500 lb., also fired on the "Lopulco" system. The dust problem, it seems, also is practically solved. German engineers have given close and continuous attention to this and other items associated with pulverised fuel firing, but it is gratifying to learn that the British device invented by Davidson and Son is being adopted in power stations on the Continent, and that this type of dust collector installed at Derby showed on tests an efficiency of 86·5 per cent.

ONE of the methods of studying the constitution of coal is to examine the results of treating the fuel by organic solvents which, especially at high pressures, extract some of the coal substance. The extract may be resolved into several oily and solid fractions, and considerable discussion has ranged round the question as to whether one of these, and which, is responsible for the coking properties of a coal. It has been questioned whether the extraction made at 285 deg. Cent. is purely physical or brings about a decomposition of the coal. Professor W. A. Bone, L. Horton, and L. J. Tei, according to a paper presented before the Royal Society on November 1st, believe that no such decomposition occurs, and in this agree with the observations of other workers who find decomposition setting in only above 300 deg. Cent. The extracted matter pre-exists as such in the coal. The authors found that the soft oily portion of the extract does contribute to the coking, although this is chiefly bound up with a solid fraction of the extract. From an examination of coals of varying geological age, it was concluded that the oily extracts are obtainable from the younger coals. The counterpart of the solid extract found in the less mature coals is of a phenolic character.

Miscellanea.

A NEW bridge is to be built over the Danube at Budapest at a cost of some 25 million pengős.

THE output of Portland cement from Yugoslavia last year was 712,740 tons. Egypt was the principal customer.

THE output of copper from the Katanga copper mines of the Congo reached the record of 9800 tons during August.

IT is reported that Guest, Keen and Nettlefolds, Ltd., propose to establish a by-product plant at the Wern Tawr Colliery.

THE pulverised coal-burning plant for the new steamer of the Berwindmoor Steamship Company is to be supplied by Clarke, Chapman and Co.

A LOW-TEMPERATURE carbonisation plant of the Illingworth type, with a capacity of 250 tons a day, is to be erected at Allerton Main, near Leeds.

IT is announced that a large natural gas field has been found near Collingwood, Ontario. One well has already been sunk and yields 200,000 cubic feet a day.

THE Newcastle, South Africa, blast-furnace was blown in again in the middle of October, after a shut-down of twelve months on account of the accumulation of stocks.

THE chromite deposits in the Bosûlar district, in the Vilayet of Brussa, and also those near Kaalik, are to be worked under a sixty years' concession by a Turkish company.

IN addressing the shareholders of the Anglo-Persian Oil Company, the chairman, Sir John Cadman, said that a notable change has been effected in the distillation of the crude oil, which now involves a single, instead of a double, operation.

THE new three-hinged steel bridge across the Colorado River at Marble Canyon is the only road bridge for a distance of 600 miles. It has a span of 616ft., and there is 467ft. of headway above the river. All the 1500 tons of material for the bridge had to be taken by road a distance of 130 miles. The maximum weight of a single piece was about 12 tons.

ACCORDING to the *Chemical Trade Journal* and *Chemical Engineer*, two brothers, R. and E. Henderson, who have been unsuccessfully searching for oil are reported by the *Central News*, in a message from Toronto, dated November 10th, to have discovered on a farm near Maple, Ontario, the world's largest radium-containing well. The brothers are said to have refused an offer running into seven figures. Experts have pronounced in favour of the discovery.

THE new type of vehicle which the London General Omnibus Company has recently placed in commission on the Victoria–Cricklewood (16A) route represents an important advance by the company in the mechanical construction of their vehicles. The method of propulsion is petrol-electric and the drive is gearless. The significance of this for the comfort of passengers will be appreciated by those familiar with the Tilling-Stevens petrol-electric omnibuses in London, Brighton, and elsewhere.

ORDERS for British aircraft to the value of over £250,000, embracing all types of machines, from small two-seater Avro Avian light aeroplanes to huge two-engine Supermarine Napier flying-boats, have been received in Britain during the past few weeks. The bulk of the orders have been placed by Australia and Canada, but a considerable number are also being placed by Chile and Japan, while, after recent demonstration flights of the Vickers-Napier "Vivid" in Rumania, further orders are expected at an early date.

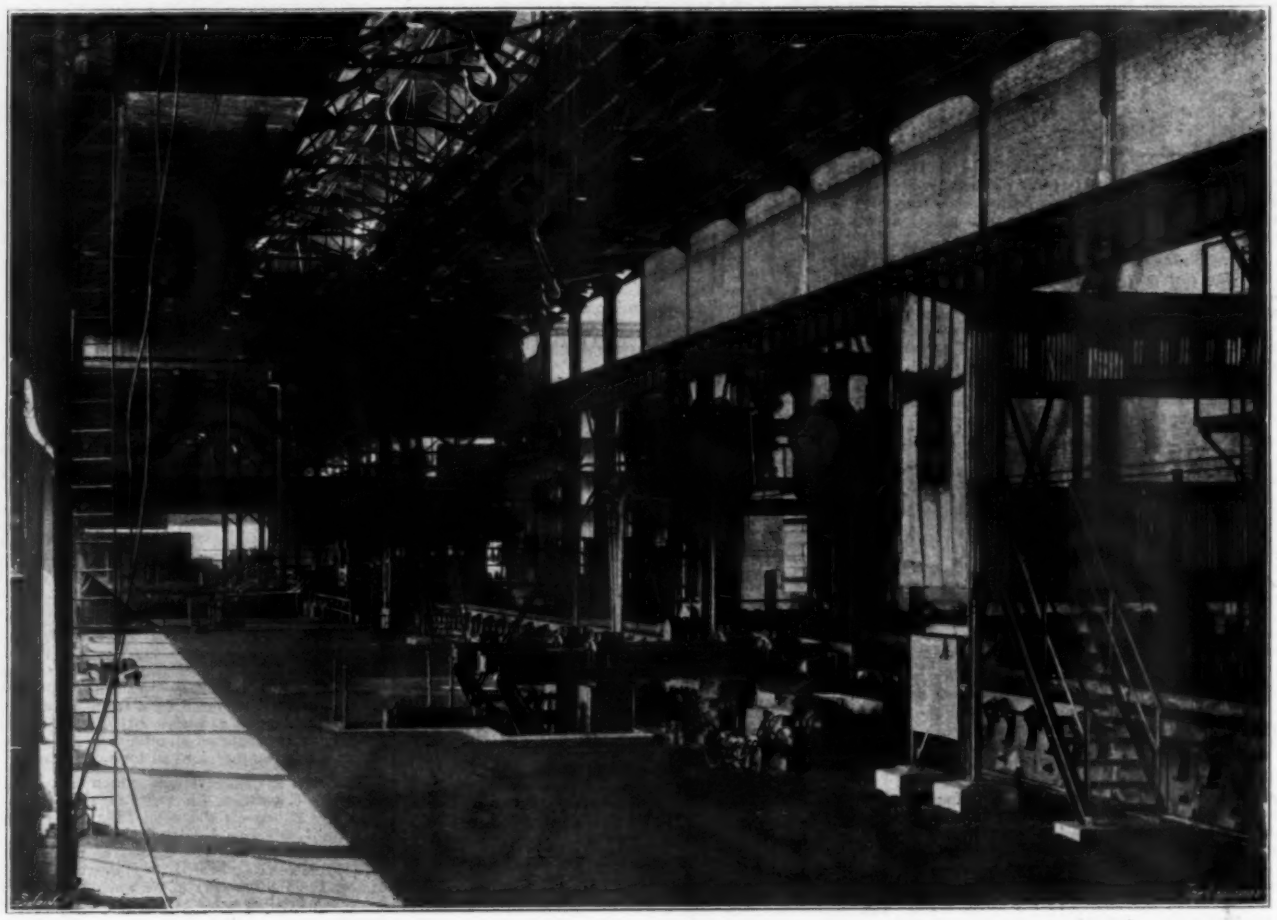
PLANS for the construction of a new vehicular bridge connecting the island of Montreal with the south shore of the St. Lawrence River have been completed by the Department of Public Works and Labour for Quebec, and the Commission appointed by the Quebec Legislature to deal with the matter will shortly call for tenders. The bridge will be constructed in all probability a short distance below the Canadian Pacific Railway Company's Lachine Bridge, and will span the St. Lawrence to Caughnawaga, thus linking up the island of Montreal with the counties of Chateauguay, Huntington, and Napierville-Laprairie.

THE Grimsby Town Council has decided to promote a Bill in connection with the proposed new fish dock at Grimsby. The building of such a dock has long been contemplated by the London and North-Eastern Railway Company, but recently they intimated that they could not raise the necessary capital, and suggested that if the Grimsby Corporation were prepared to raise a loan and build the dock, they would pay as a yearly rental what the Corporation had to pay in interest and sinking fund, as well as any other expense incurred until the dock was paid for. As security, the railway company offered the Corporation the whole of their revenue. Mr. W. J. Womersley assured the Council that the scheme would not cost the ratepayers of Grimsby one penny piece. The security offered by the railway company was the best they could get, as the Corporation would have preference over the debenture holders. Besides, the dock would belong to the Corporation until the railway company had paid their last instalment.

THE annual reports of his Majesty's Inspectors under the Quarries Act, 1894, and the Metalliferous Mines Regulation Acts, 1872 and 1875, for the year 1927, which are just issued by the Mines Department—Stationery Office, 1s. net—deal primarily with questions relating to the safety and health of workers in and about metalliferous mines and quarries, but they contain a great deal of information also as to the number, scope, and variety of mineral workings. The chapters on accidents and their prevention are, however, the main feature of the reports. It is pointed out that during the period of a little more than thirty years, for which statistics are available, the death-rate from accidents "inside" the quarry has been reduced by one-fourth, while that of other quarry workers is practically the same. The reduction "inside" the quarry—namely, from 1·57 deaths per 1000 persons employed in 1895–1904 to 1·18 in 1923–27—is primarily due to the decreased number of accidents from falls of ground, namely, from 0·73 to 0·55, and secondarily to the "miscellaneous" accidents, namely, from 0·61 to 0·45.

THE JAMSHEDPUR WORKS OF THE TATA IRON AND STEEL COMPANY, LTD.

(*For description see page 572*)



40IN. BLOOMING MILL IN THE NEW PLANT

RAIL MILL IN THE NEW PLANT

The Engineer

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THE ENGINEER.

NOVEMBER 23, 1928.

The Veneration of Theory.

GREAT as have been the developments during the past half century or so in the branches of physical science cognate to engineering, it remains true that there is still a considerable lack of *rapprochement* between technical engineering and physics. In many noteworthy and highly creditable instances the physicist can help the engineer to a complete understanding of the facts underlying the natural phenomena which he encounters or endeavours to make use of in his practical work. But in other instances, no less notable or numerous, physical science is as yet unable to provide the trustworthy guidance which the engineer requires and expects of it. In some cases it is wholly dumb; in others, and more usually, it enunciates its opinions haltingly and with qualifications which render its pronouncements of little or no practical value. Consider some of the great branches of theoretical physics and their present relationship to practice; hydro-dynamics and naval architecture, the theory of air flow and the construction of aircraft, thermodynamics and the design of prime movers, theoretical elasticity and constructional engineering. In each case practice at many points derives assistance from the related theory; but very strikingly, at many other points the assistance desired is absent or even turned to opposition. The problem which is completely amenable to calculation from first principles is exceptional and unfortunately is, in general, also of minor importance. The really large and important problems are mostly either incalculable or yield to calculation when we make assumptions or impose conditions which are not in accordance with our practical limitations or aims. Nevertheless, in spite of its numerous shortcomings and disabilities, theory is growing, not diminishing, in the veneration of practical engineers. In an important respect the situation is, philosophically and practically, disquieting. It clearly favours the adoption of ways and methods which yield to theoretical treatment and encourages the neglect of alternative ways and methods which, though equally capable of being realised in practice, are outside the limits of theoretical calculation.

In bygone years the adaptation of tradition and precedent was the main source of engineering progress. To-day that process of development is giving way to an evolution inspired by so-called first principles. More and more are practical engineers relying upon theoretical principles to guide them towards fresh achievements. More and more are they endeavouring to bring their practice into line with established theory and less and less are they demanding of the theorists that they should bring their theories into line with practical conditions and limits. The phrase "the imperfections of practice" has insensibly acquired a new meaning. It no longer signifies exclusively the failure of the workshop to realise with mathematical exactitude the intentions of the drawing-office. It is extensively employed to-day to cover the lack of agreement, the frequent, almost, we might say, the usual, lack of agreement between theory and practice. The minds of many modern engineers are impressed with the belief that theory is the essentially perfect and practice the essentially imperfect partner. We are encouraged to speak of a "perfect" gas and of the "ideal" efficiency of a heat engine. The hydrodynamician bases his theories on an "idealised" fluid and the elastician visualises a solid possessing "perfect" elasticity. If the results achieved in practice do not fulfil theoretical predictions we are told that it is because of the "imperfect" nature of the materials employed or of the "imperfect" manner in which they are applied. This treatment of practice by the theorists is presumptuous. The truth is that with some rare exceptions they cannot for the life of them take into their consideration all the factors in a practical problem. Their "perfect" gases, fluids, and solids are really *simplified* bodies and are set up because, without simplification, calculation and mathematical treatment would be impossible. Consider, for example, the existing complexities of theoretical elasticity and then reflect that they spring from the contemplation of a delightfully unreal body which is completely isotropic in all senses and obeys Hooke's law with absolute rigidity. Consider the impossible state of complexity which would arise if thermo-dynamicians were compelled to take account of the fact that no gas completely obeys the simple laws propounded by Boyle and Charles. Consider the significance of the fact that the hydrodynamician is forced to specify a different idealised fluid for different problems and sometimes even to vary the supposed properties of his fluid in passing from one to another aspect of the same problem. If the word is admissible at all into the argument, surely the charge of "imperfection" lies entirely against the suppositions of theory. The only perfect materials, the only perfect conditions are, we might well claim, the materials and conditions of practice. If practice fails to agree with or fulfil theoretical predictions the fault lies with the imperfect material and conditional assumptions made in the course of the theoretical treatment. Not only does theory take liberties with the materials and conditions of practice: having taken these liberties, it not infrequently finds itself faced with a situation which is beyond its calculative ability. In its treatment of many practical problems—not necessarily complex—it speedily encounters non-integrable expressions or is unable to proceed because the problem is of the indeterminate order. When problems of this kind arise there is a growing tendency in practice to solve them by modifying their nature to a form which theory can handle, even although such modification may sacrifice the achievement of some part of the practical object in view. There is a belief current that if a practical proposal is found to be outside theoretical treatment that proposal must be unsound or at the best less efficient than some alternative proposal that is within the bounds of calculation. The very sound of the word "indeterminate" applied to a structure carries with it to many an immediate suggestion of inefficiency. If they are told that the theoretical investigation of their proposals involves expressions which cannot be integrated they at once suspect that there must be something wrong with their proposals. Actually it is not possible to integrate more than a few typical expressions, however they may arise. Actually indeterminate structures are indeterminate only in the mathematical sense; in practice they are perfectly definite and may be quite good structures. The selection of a practical procedure amenable to theoretical treatment in preference to one which is not so amenable can never be justified on the ground that the procedure which is amenable must

of necessity be better than the other. Its amenability is largely fortuitous and implies nothing by way of superiority. The pin-jointed structure is not, as such, more efficient than one with rigid joints. It may indeed be less efficient. When it is employed it is preferred because it yields to a mathematical treatment which permits the primary stresses to be calculated with considerable certainty. But the attainment of certainty is not synonymous with the attainment of efficiency. The price of certainty may be and probably usually is the sacrifice of some degree of practical efficiency.

Not so very long ago in the history of engineering theory of any kind was widely despised and progress was sought by a gradual extension of past successful practice. To-day the impetus to progress is being sought increasingly in theoretical studies and theory, once the object of unmerited despite, is being accorded an equally unmerited measure of veneration. It is greatly to be feared that the false or exaggerated value now commonly given to theory is the result of over-emphasis placed on its merits by those responsible for the scientific training of the new generation of engineers, and of their failure to impress their students with the definite and narrow limits within which theory, even yet, is applicable to practical engineering. The accord between theory and practice is a subject of study to which far too little attention is paid. It is usually thought sufficient to teach theories and to leave the students to find out for themselves by experience how far the theories they have learnt correctly represent natural phenomena. Such a procedure is good neither for theory nor for practice. When discrepancy after discrepancy is encountered the natural tendency is either to condemn theory out of hand or to acquire an altogether erroneous and harmful conception of the "shortcomings" of practice. Sensible instruction would prepare the student for the inevitable lack of agreement and would show him how to take advantage of the discrepancies as a means of improving theory. It would serve an excellent purpose if someone with sufficient leisure and ability would compile a history of defunct or deficient theories. The entries in such a work would not be confined to ancient times. They would range from the days before Copernicus gave the world a new conception of the planetary movements to yesterday when, after a life of but ten years, the quantum theory of the constitution of matter was laid to rest. Theories are fingerposts on the road to advancement, and properly used can as such prove of the highest value. Some people endeavour to use them as if they were self-propelled carriages that will take them to their journey's end. It is not surprising that on such mounts they do not get very far and that, failing in their object, they revile the signposts and those who set them up or condemn the road for not following the indicated course.

Improving the Load Factor.

ALTHOUGH the persistent efforts which engineers have made to raise the thermal efficiencies of power stations have reduced the price of current, it is obvious that in the case of some of the most efficient stations further savings in fuel consumption cannot make very much difference to consumers. Indeed, if some stations obtained coal free of charge the consumers would derive little benefit. There are so many heavy charges for distribution, rates and taxes, &c., that the cost of fuel in a modern station is not a matter of paramount importance to users of electricity. High thermal efficiency must, nevertheless, be aimed at and old and inefficient plant should, of course, continue to be replaced by the most efficient available. The utilisation of waste heat, the possibilities of low temperature carbonisation, the adoption of higher pressures and similar developments call for the fullest consideration. Regarded from another point of view, the possibility of filling in the valleys in the load curve deserves increased attention, for additional load applied at the right time can benefit the running accounts of a supply undertaking. As Dr. Ferranti remarked during the course of one of the discussions at the Civil Engineers' conference, the design of the load claims attention as well as the design of the plant. This subject is very much to the fore at the moment. Mr. Geo. Wilkinson, the late Chief Electrical Engineer at Harrogate, has devised a "change circuit" system which automatically heats up water electrically as the normal load diminishes. For the purpose he employs an induction regulator, which supplies current at variable voltage to an additional circuit as the normal load at constant voltage is reduced. At night, and particularly during the bedtime hours, when the demand on the plant for ordinary purposes is small, current is supplied to heaters in well-lagged thermal storage tanks, from which hot water may be drawn as required in works, hospitals, private houses, and other establishments. Distribution of a given amount of power on this "change circuit" system is cheaper than equivalent distribution on the constant pressure systems, for at times of heavy load the pressure is twice that of the constant voltage system.

In an article in the March issue of *World Power*, Mr. M. O. F. England proposed to control the supply of heating current from generating stations or sub-stations by means of small pilot wires and without the provision of new power-carrying cables. The article gave rise to a fair amount of correspondence, most of which supported the idea of thermal storage. On the questions of how the load should be regulated and the price of heating current, however, there appears to be some diversity of opinion. Not a few disagree with Mr. England's contention that heating current could be supplied at night at the rate of ¼d. per unit. While the supply of this current on a "near fuel cost" basis may appear to be a satisfactory scheme, it must not be forgotten that whatever system of supply is adopted additional capital cost is involved. Even the simple time switch method of switching on the heating apparatus at predetermined hours involves additional capital and operating expense, for it calls for a time switch and special meter on the consumer's premises. The cost of the consumer's water heating apparatus may also prove a detriment to the general adoption of the idea. That electricity must be sold at a very low price in order to compete with other methods of heating water every electrical engineer is well aware, and it remains to be seen whether the proposals that are now being put forward can materially improve station load factors. By all means let the scheme have a trial; in fact, every possible method of improving the night load should be given the fullest consideration, such, for instance, as the electric baking of bread. At one time it was thought that the electric vehicle would prove a boon to the electric supply industry, but up to the present it has not done so. For most purposes the modern petrol vehicle has proved far superior. Nothing is more badly needed than an inexpensive storage battery with a capacity far in advance of the present battery of given weight. If ever such a battery arrives it will revolutionise electrical engineering and completely upset many existing ideas. Electric trains might be run without overhead or contact rail equipment or cables and sub-stations, and the batteries might be charged at night.

Meantime it is necessary carefully to examine every alternative scheme that aims at loading up electric generating plant at night, such as that of storing energy in the form of heat. Many believe, however, that electric heat is a poor competitor with other forms of heat for continuous heavy duty. Discussing Mr. England's article in a letter to *World Power* of April of this year, Mr. L. L. Robinson, the Borough Electrical Engineer of Hackney, drew attention to an old idea. In fifty years' time, he said, the engineers of to-day will be looked upon as historic madmen for having transferred certain generating stations to riverside sites in order more easily to throw away 60 per cent. of the heat of the fuel into the rivers. It is important to note, he pointed out, that the natural demand for heating occurs during the natural demand for light and power, so that if means could be found for marketing exhaust steam the time of greatest demand and supply would be coincident. That there are difficulties in carrying out the scheme Mr. Robinson fully recognises, but that they will always remain insurmountable he does not believe. In fifty years' time, and perhaps long before, many drastic changes may occur in electrical engineering. The fact to be kept in view at the moment, however, is that, rightly or wrongly, the erection of large riverside stations has deemed to be desirable, and one of the problems before supply engineers is to find ways and means of loading up the plant during hours when the ordinary demand is at a minimum.

Obituary.

ANDREW EADIE.

THE death occurred at "Inverallan," Pollokshields, Glasgow, on November 11th, 1928, of Mr. Andrew Eadie, chairman of the Scottish Tube Company, Ltd., of Glasgow.

Mr. Eadie was formerly principal partner of the firm of James Eadie and Sons, Clydesdale Tube Works, Rutherglen, which was founded in 1832, and was the first to manufacture gas tubes in Scotland. During his long connection with the firm, Mr. Eadie was identified with the development of iron boiler tubes, particularly for use in marine boilers, and also with the development of loose flange tubes and joints for the colliery trade. "Eadie's" loose flange joints are well known among colliery managers.

When the firm of James Eadie and Sons was incorporated in the Scottish Tube Company, Ltd., Mr. Eadie became vice-chairman, and at the death of Sir Thomas Mason in 1924 was appointed chairman and managing director. He had always taken a very active share in the management of the company, and was at business every day up till two days before death. He was in his seventy-fifth year.

Literature.

Industrial Management. By RICHARD H. LANSBURGH. London: Chapman and Hall, Ltd. 1928. Price 22s. 6d. net.

MANAGEMENT, the unseen force behind the activity of every factory, has developed very rapidly, so much so that a close study of it is now essential, the days of rule-of-thumb method having definitely passed away for ever. Even within the last five years many changes of an evolutionary character have been taking place, as is evidenced by the fact that a work on the subject published in 1923* is no longer considered adequate, for when a new edition was required it was decided to rewrite and reset the whole book. "Industrial Management" continues to preach peace and goodwill in the world of production, and retains all the excellent features of which we were able formerly to speak in high terms.

The trend of modern progress may be gathered by a scrutiny of both additions and omissions, which have rendered this treatise up to date. The first new chapter we notice is one on material handling, a subject far too much neglected in the past, though a very superficial investigation will disclose the fact that most products spend more time in travelling to and fro than on machines where actual work is being performed upon them. Elimination or reduction of unremunerative journeys may conceivably effect far more economies than improvements in methods of machining, important though they admittedly are. Mr. Lansburgh gives a number of typical instances of process conveying in a chapter that is particularly well illustrated.

A new chapter (XV.) is devoted to industrial safety, which opens with the amazing statement that "twenty to twenty-five thousand workers in industry within the United States are killed annually while in the course of their employment. Two million suffer non-fatal accidents of varying degree which make them miss days of employment." Surely there is much food for thought in these appalling figures, and, ignoring the humanitarian aspect entirely, it is evidently a business proposition to investigate the causes with a view to minimising the occurrence. The necessity for educating the worker, and even going further and instructing those who are likely one day to be industrial workers, is rightly stressed. Accident prevention will lead to increased production, decreased overhead charges, and decreased labour turnover, as well as the more obvious saving in money compensation.

Considerably more attention has been given to the development of specialised machinery—Chapter XVII.—which has made such rapid advances in America. That it is not confined to that continent was abundantly proved by the recent show at Olympia, but we cannot claim that there is any approach to that degree of standardisation which the author advocates. When we come to the question of standardisation of the product—we notice that Mr. Lansburgh now speaks of it as "simplification"—we are in full agreement as to the advantages that may be gained, but must point out that manufacturers are too frequently hampered by the specifications of their customers, specifications that quite unnecessarily preclude the possibility of extensive standardisation.

Our attention is arrested by the omission of the chapter on the "Objections of Labour to Time Study," and while wondering whether this may be taken as an indication of a more enlightened view, we turn to a new chapter (XXXIV.) entitled "Organised Labour and Management," and are not altogether surprised to read: "The attitude of organised labour to modern industrial management has changed very greatly in recent years. At first actively hostile to some of the fundamental principles, organised labour now heartily endorses and takes as its own basic policies some of those management ideas which its earlier leadership fought," and again, after enunciating Taylor's views on the folly of restricted output, we are told: "Taylor's attitude of yesterday has become the attitude of enlightened union leaders of to-day." Though we feel that in this respect the United States are ahead of us, we are convinced that there is a definite improvement in this country also.

When reviewing the first edition we said that we should like to have seen more space devoted to the

* Reviewed in THE ENGINEER, May 23rd, 1924.

planning and other centralised departments, and accordingly we are glad that the author has taken the opportunity of materially strengthening this section, and the additional matter is very valuable. We also welcome the additions to his exposition of "Management Control Through Costs"—Chapter XLVII.—fully endorsing the opinion that cost accounting "is only of value in so far as it aids operations and in the making of intelligent executive decisions which will promote the healthy advancement of the business." There is another important proviso that "cost reports must be on current periods if they are to serve for management control." Too often we find that returns that would have been invaluable if rendered earlier have lost their usefulness by being furnished long after the completion of the work. "Inquests" may have an appropriate function, but they can only be of service in connection with future orders. While we admit that the author could not elaborate the different systems in vogue, we feel that he might with advantage have defined the basic principles on which each of the recognised methods of cost accounting is determined.

To render the various charts more useful an indication of the total *personnel* is desirable, for while we support the contention that "in small businesses the desire to have a substitute for each executive sometimes leads to a surplus of executives," we are equally sure that small businesses also have a tendency to attempt an organisation based on that successfully adopted by a large concern, and the results have not been encouraging.

"Industrial Management" has been improved by being rewritten; we are given less detail as to the early history of management, the effect of the Great War is shown in truer perspective now that it is becoming more remote, and subsequent trade depressions have been practically ignored. This, coupled with a process of concentration and more careful classification, has enabled the new matter to be added without an undue increase in the size of the treatise. There is a very noticeable improvement in the illustrating of the text, and the selected bibliography has been considerably augmented. Mr. Lansburgh has again produced a work which will rank as one of the standards in a subject, the importance of which is increasingly recognised by progressive manufacturers.

Underground Practice in Mining. By Bernard Beringer. London: Mining Publications, Ltd. Price £1 net.

Perhaps the first feeling produced in the reader by the perusal of this book will be one of regret that the author has not thought it worth while to learn to write his own language correctly. The English of the work throughout is slipshod to a degree unusual even in mining books, which can unfortunately not claim to be particularly free from error in this respect. The author is constantly using such phrases as "this figure will permit enhancing," when he means that the figure is capable of being increased; "is designed to relieve the weight from the middle of the headgear," when he means "is designed to relieve the middle of the headgear from the weight"; &c. &c. Even technical phrases are not used correctly. For example, the author constantly speaks of "hauling" where he means "winding." The plan of the book itself is such as to offer serious difficulties. The book is supposed to cover the whole of metalliferous mining. Although there is nothing in the title to suggest that coal mining is included, it is, as a matter of fact, deliberately left out of consideration. Even so, the author has set himself a practically impossible task in attempting to cover the whole of metalliferous mining in a book of 255 pages. It is divided into nineteen chapters, covering nine different heads, namely, Support of Workings; Shafts; Subsidiary Development; Stoping; the Application of Explosives in Breaking Ground; Compressed Air Practice in Mining; Mine Ventilation; Mine Sampling; and Mine Organisation. It will be seen that these headings cannot be said to cover the whole subject of mining fully; but, even so, an adequate consideration of each one of these heads would demand more space than has been devoted to the entire book. Necessarily, therefore, many parts of the subject are slurred over or receive quite inadequate treatment; but, in addition to defects arising from this cause, the work contains a regrettable number of definite misstatements. For example, the author should not commit himself to such a statement as that the freezing process "is out of the question for depths greater than 500ft. to 600ft." The last freezing sinking quite recently completed in this country is just over 600ft. in depth, and reference to the work "Vertical Shaft Sinking," by E. O. Forster Brown, published last year, gives on page 182 a list of shafts sunk in the Belgian Campine by the freezing process, the shallowest of which is 477 m., or 1565ft., in depth. Again, the author's statement that the Galloway scaffold "consists of a circular platform" is quite wrong. The essential characteristic of the Galloway scaffold is that it consists of two platforms, as the author could easily have found out by consulting Galloway's own book, "Lectures on Mining." Again, in dealing with the subject of pumping during sinking, the author commits himself to the definite statement that "sinking pumps are suspended . . . in a circular shaft from the Galloway stage." The author may have seen pumps so suspended, but it is certainly by no means the usual practice. One of the defects of this book is no doubt due to the fact that the author appears to think that his own experience covers the whole of mining. It may be safely said that the experience of no one man, however wide it may be, is sufficient for this purpose, and that anything like a full treatment of the subject must draw upon experience from all parts of the world. Failure to recognise this fact is responsible for such statements as that in dealing with timbering in stopes, "cheap timber, such as blue gum or casuarina, is advocated." A Cornish miner, who has probably never even heard of either of the timbers in question, can hardly be expected to be very grateful for such advice. Scattered throughout the book there are to be found here and there shrewd reflections which the author has drawn from his mining experience, but taking the book as a whole, it is not unfair to say that it contains too many inaccuracies to be a safe guide for the student in mining, and is too superficial to be of any real use to the experienced miner.

Handbook of Mechanical Refrigeration. By H. J. Macintire, M.M.E., Associate Professor of Refrigeration in the University of Illinois. London: Chapman and Hall, Ltd. Price 37s. 6d.

This monumental work—which may well be called an emporium of refrigeration—comprises 716 pages of matter with, in addition, many folding plates. The author is Professor of Refrigeration in the University of Illinois, and much of the material of the book has been gathered and used for teaching purposes. The fault of the book is that much matter of interest is hopelessly buried in masses of tables taken from manufacturers' catalogues. For instance, under condensers, we find 16 pages of standard flanges and valves of the different manufacturers. Furthermore, it is carelessly put together. Five pages are headed "Concrete Brine Tanks." In them there are nine lines of rather vague description of the construction of the brine tanks, while the rest consists of tables of the capacities of double pipe brine coolers and other matters which have nothing to do with concrete tanks at all.

The chapter on the automatic refrigerating machine is interesting, and gives the best description of these small plants which we have seen, but we wondered when we read the description of the Munters-Platen absorption system, which says: "While this system is ingenious, it requires several constant conditions for success. The total pressure must remain constant, and there must be no leakage of hydrogen. As most refrigerating machines have a variable condenser pressure depending on the amount and the temperature of the condensing water, it is not clear how successful the Munters-Platen system will be. It undoubtedly will be limited, under any circumstances, to the gas-fired machine." Actually, the Munters-Platen absorption system is probably one of the most ingenious ever devised. Hundreds of these machines are working to-day with electric heating elements, and there is certainly no doubt whatever of the success of the system.

There may be much of interest and value hidden away in these 716 pages, but it is hard to find, and the value of the book would be considerably enhanced by a better grouping of the numerous tables and diagrams, and also by a drastic pruning of the various manufacturers' lists, fittings, parts, sizes, &c.

SHORT NOTICES.

American Railway Signalling Principles and Practice. Chapters VII., VIII., and XXIII. Published by the Signal Section, A.R.A., 30, Vesey-street, New York.—We have on a previous occasion referred favourably to some of the pamphlets issued for the use of railway employees by the American Railway Association. Each of these pamphlets, which can be obtained by non-railway men for prices varying between 10 and 25 cents, forms one chapter of what, when it is finished, will be a complete text-book. They are all very well done, great care having been taken to make the meaning quite clear to practical men. The three latest chapters deal with Direct-current Track Circuits, Chapter VII; Transformers, Chapter VIII; and Highway Crossing Protection, Chapter XXIII. They are as good as their predecessors, and one of them, transformers, is, apart from its interest to railway signal engineers, a useful little treatise in itself on small transformers.

Handbook Encyclopædia of Engineering. The Industrial Press, New York; and the Machinery Publishing Company, Ltd., London. 1928. Price 30s. net.—There have been various efforts to produce encyclopædias of engineering, and it cannot be said that any of them reach a high plane. The book before us is no better than its predecessors, and owing to the smaller size of page is, in fact, not so good as some of them. All such works suffer from two or three common defects. The compiler is faced with the problem of what to leave out. If he is consistent and puts in everything he overloads the volume with a great deal of elementary matter which an ordinary dictionary would supply quite as well; if he decides to omit, as, for obvious reasons, he must do, he has to make selection from an enormous mass of material. That is the plan followed in the present case and not always with discretion. Take, for example, such an important detail as the Michell, or, as it is called in America, the Kingsbury, thrust bearing. It is not mentioned anywhere by name and there is no description of it. Again, there is no mention of the "closed circuit" as employed on steamships, none of steering gear, engine indicators are not described and the notes on locomotives, turbines and many other things are too scanty to be of any real value. But whilst there are these omissions of important subjects, many trifling commonplace things are dealt with and there are a good many references to economic questions, like wage systems. It is impossible that in any such book there should be a total absence of useful references, but they are in this case submerged by matter which might well have been omitted, and the searcher will too often suffer disappointment when looking for subjects of prime importance.

Volumetric Glassware. By Verney Stott, B.A., Senior Assistant, National Physical Laboratory. London: H. F. and G. Witherby. 1928. Price 20s. net.—There are ways and ways of handling technical subjects. They may be treated with the repellant dryness of many school text-books—surely of all books those that ought to be made interesting—or they may be composed in the style that Huxley and Tyndall brought to perfection. In this volume, if the author does not reach the high standard of those great technical stylists, at any rate he keeps miles and miles away from the dry-as-dust school of authors. Indeed, one would hardly have thought that the problems presented by volumetric glassware could be put into a form so attractive that the reader is led on page by page and puts the book down with regret. Possibly the reason is to be found in Mr. Stott's intimate acquaintance with the subject, and the essentially practical nature of the treatment. The book is, of course, not of the "popular" order, for it is intended primarily for men who have to use volumetric glassware in chemical, metallurgical and physical laboratories, but the author states the problems with an admirable lucidity, follows his arguments logically, and gives conclusions which jump to the eye readily. There is a great deal of thoroughly practical information in every chapter derived from experience gained at the N.P.L. Here is a little scrap which may be handy to engineers when they find difficulty in reading a meniscus. Wrap round the tube a narrow strip of black paper and fasten the free ends together with an ordinary wire paper clip. See that the top edges coincide accurately. Slide the paper until it is about one millimetre below the bottom of the water meniscus, and hold a white card behind the tube. The bottom of the meniscus then appears quite black, and its outline is very sharply defined against the white background. We give that as a single example of many useful suggestions in a book which certainly must reach the hands of all who have to measure volumes or weights accurately by graduated glass vessels.

BOOKS RECEIVED.

Les Cycles irréversibles et la Turbine Van den Bossche. By J. Van den Bossche. Paris: Chaleur et Industrie, 5, Rue Michel-Ange.

Administration Report of the Commissioners for the Port of Rangoon. April, 1927–March, 1928. Rangoon: The British Burma Press.

Engineering Education. By Roy Palmer. Second edition. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 10s. net.

A Bibliography of Metallic Corrosion. By W. H. J. Vernon. London: Edward Arnold and Co., 41, Maddox-street, W. 1. Price 21s. net.

Strength of Materials. Seventh edition. By A. Morley. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 12s. 6d. net.

Spectroscopy of the Extreme Violet Ray. By T. Lyman. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 10s. 6d. net.

Proceedings of the South Wales Institute of Engineers, Vol. XLIV., No. 5. Cardiff: The South Wales Institute of Engineers, Park-place. Price 5s. net.

British Floods and Droughts. By C. E. P. Brooks and J. Glasspoole. London: Ernest Benn, Ltd., Bouverie House, Fleet-street, E.C. 4. Price 10s. 6d. net.

Canadian Trade Index, 1928. Toronto: The Canadian Manufacturers' Association, Incorporated, 14th Floor, 67, Yonge-street, Canada. Price 6 dollars net.

Chemical Plumbing and Leadburning. By E. B. Partington, A.R.S.I. London: Allen-Liversidge, Ltd., Victoria Station House, S.W. 1. Price 3s. 6d. net.

Alkaline Accumulators. By J. T. Crennel, B.A., and F. M. Lea, M.Sc. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 10s. 6d. net.

Report of the Departmental Committee on Examination of Masters and Mates. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 9d. net.

Hints to Coal Buyers. Third edition. By Lieut.-Commander C. E. Evans, R.N.V.R. Cardiff: The Business Statistics Company, Ltd., The Exchange. Price 15s. 6d. net.

Minutes of Proceedings of the Institution of Civil Engineers. Vol. 225. Edited by H. H. Jeffcott. London: The Institution of Civil Engineers, Great George-street, S.W. 1.

The Support of Underground Workings in the Coalfields of the South Midlands and the South of England. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2.

Annali dei Lavori Pubblici (già Giornale del Genio Civile). Ministero de Lavori Pubblici, Consiglio Superiore, Agosto, 1928. Rome: Provveditorato Generale dello Stato, Libreria. 1928.

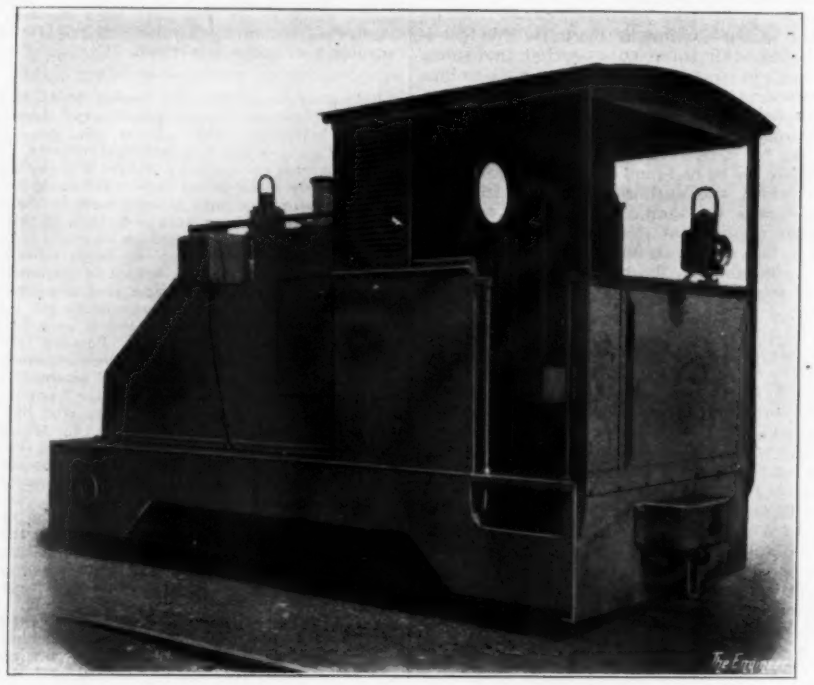
Empire-grown Sisal and its Importance to the Cordage Manufacturer. October, 1928. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 6d. net.

The A B C of Storage Battery Management. Second edition. By E. C. McKinnon, M.I.E.E. Manchester: The Chloride Electrical Storage Company, Ltd., Clifton Junction. Price 3s. 6d. net.

Naval Operations. Volume IV., Text, and Volume IV., Maps. By Sir Henry Newbolt. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price: Text, 16s. net; and Maps, 5s. net.

SMALL HEAVY-OIL ENGINE LOCOMOTIVE

KERR, STUART AND CO., LTD., STOKE-ON-TRENT, ENGINEERS

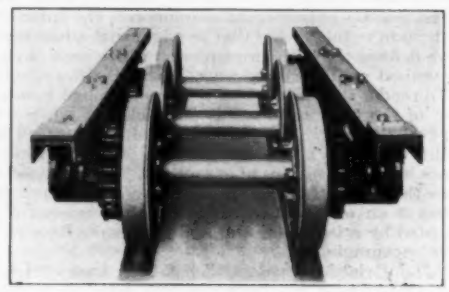


A Heavy-Oil Engine Locomotive.

THE engraving and drawing which are given herewith illustrate a type of small locomotive, fitted with an internal combustion engine, which has recently been developed by Kerr, Stuart and Co., Ltd., of California Works, Stoke-on-Trent, and has already been supplied for several services, both in this country and abroad.

Its outstanding feature is perhaps the adoption of the McLaren-Benz type of Diesel engine as a propelling unit; but as we have already dealt with this engine, it is unnecessary to enlarge upon its detailed construction here. It is sufficient to remind our readers that this engine has the characteristic of being able to develop its maximum torque over a very wide range of speed, without there being any fear of it being "stalled," and that it will pick up speed very rapidly after it has been throttled down, when the necessity arises. It is in this direction, we think, that the new locomotive is to be specially commended, as one of the chief difficulties with internal combustion locomotives has been when, for instance, a heavy train has to be started from rest. Unless a good slipping clutch is provided, there is a liability for the engine speed to be brought down so low before the train is started that the engine ceases to fire and the whole process of starting must be repeated. With this engine, however—and we have given it some rather severe tests—the load can be increased until it is on the verge of stopping, and immediately there is the least relief in the load the engine picks up again. It is, we imagine, largely on account of this characteristic of the engine that the builders have been able to devise a satisfactory locomotive for heavy service with a simple cone clutch of moderate dimensions and a gear-box with only two speeds.

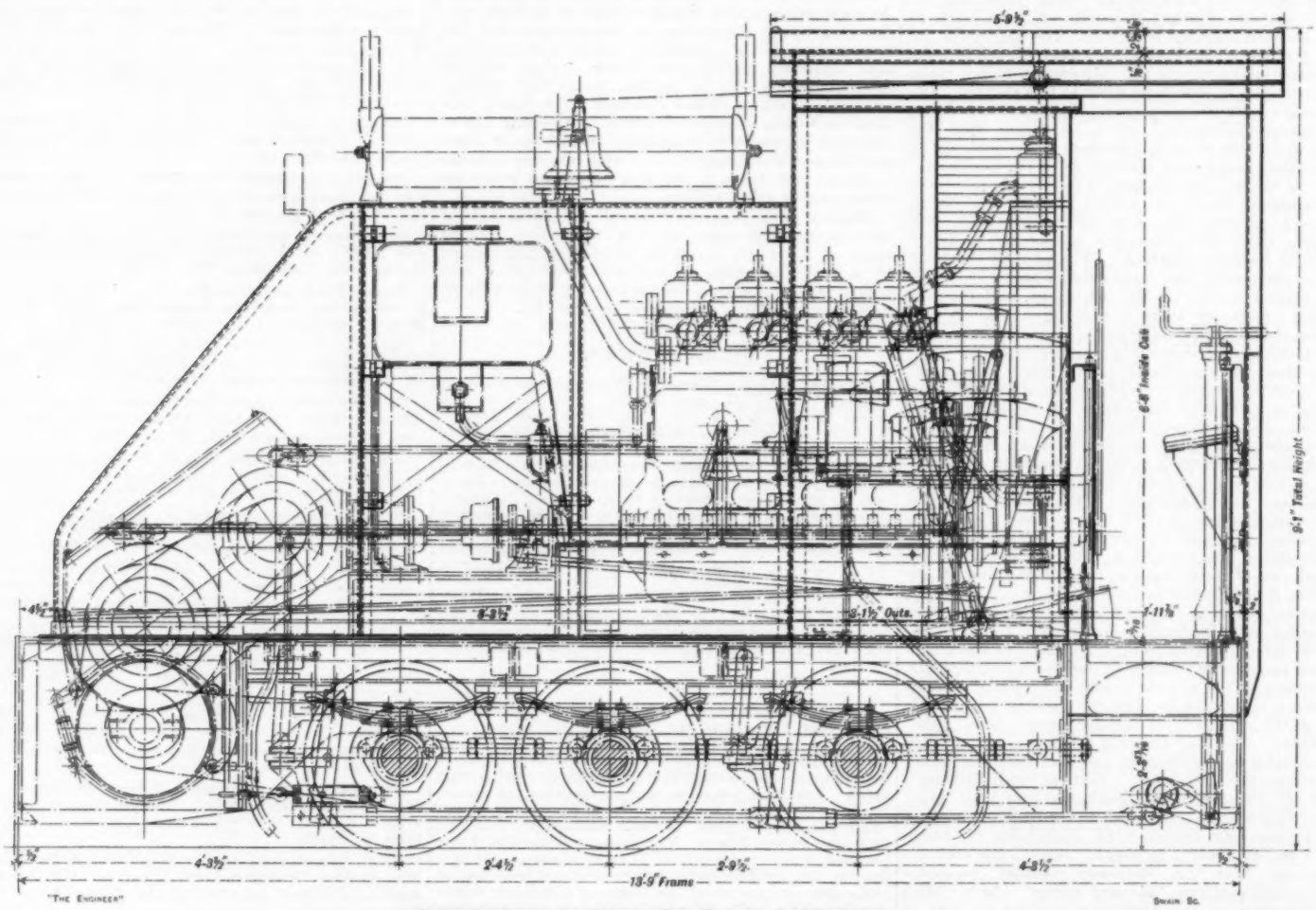
On reference to the drawing it will be seen that the engine is placed "fore and aft." It has four cylinders 135 mm. bore by 200 mm. stroke, and develops 60 horse-power when running at its normal speed. The power is transmitted to the gear-box through a simple cone clutch, lined with Ferodo material, which is operated by a foot pedal in the driver's cab. The gear-box is of the bevel wheel and chain type. That is to say, there is a bevel wheel on the propeller shaft which meshes with the two bevel wheels on a transverse shaft in the box. Either of these wheels can be clutched on to the shaft, so as to give forward and reverse drives. Two chain drives with different ratios drive a second shaft through appropriate clutches, and the whole mechanism is flooded in oil. In this way two speeds forwards or backwards can be controlled by two levers in the cab. The gear-box chains are duplicated in each case as a precaution against breakdown, but in view of the working conditions, we should think that there is little likelihood of trouble in this direction. The second shaft of the gear-box drives a jack shaft, at the end of the main frame, through spur gearing, and this shaft is connected with the driving axles by chains.



RUNNING GEAR END VIEW

The several driving axles are also coupled by chains, and no side rods are used. As a consequence, the axle boxes are not carried in horn plates, but are held by radius rods. The axle-box most distant from the jack shaft is attached to the main frame by a radius rod, and the other two axles are, in turn, dependent upon it through other rods. By these means a proper tension may be maintained in all the driving chains. It is noteworthy that the axle-boxes, springs, and so forth on these locomotives are arranged on what might be described as loose frames, so that they can be set to suit any gauge of rails from 60 cm. to 3ft. 6in. It is only necessary to bolt the loose frames on to the underframe of the locomotive in the proper position and to fit axles of the appropriate length to make a change in the gauge of the engine.

There are two distinct systems of brake gear, the usual screw-down shoe brakes, which work on the leading and trailing wheels, and a band brake on the jack shaft. The latter is operated by a hand ratchet lever in the cab, like that of a motor car, and is used for all ordinary manœuvring. The shoe brakes are only intended for bringing the engine down long inclines or holding it when at rest. All the controls are arranged on the near side of the locomotive, so that the driver can reach them quite conveniently. Within the cab, it will be noticed, there is the radiator

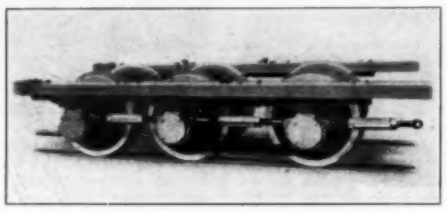


ARRANGEMENT OF HEAVY-OIL ENGINE LOCOMOTIVE

for the cooling water of the engine, and it is provided with a fan which sucks air from the cab and blows it through the engine casing, so that the atmosphere in the cab is kept fresh, and a good cooling effect for the machinery is obtained. As will be observed from the engraving, the main frame of these locomotives is of unusual depth, so that there is no difficulty in adopting the buffing and draw gear to suit rolling stock of widely varying heights.

One of the claims made by the makers for these locomotives is that they can be put in service very quickly, even after they have been standing idle for some time, and in this connection a small petrol engine of the cycle type is used for starting the main engine. It is of 4 horse-power, and can, of course, be easily started by hand. It is then clutched on to the main engine, which it will go on turning over indefinitely until it starts firing. It is, however, considered normal practice to get the locomotive going on the main engine within two or three minutes of the crew stepping on to the footplate.

Some trial runs of one of these locomotives, of 2ft. gauge, were recently carried out on the Welsh Highland Railway, between Dinas and Pwllheli, on which route there are gradients as steep as 1 in 30, and many very sharp curves. The load comprised a buffet and saloon coach, and a brake van, and after the train had once been started the engine was run on the top gear throughout the length of the journey of nine miles. The round trip—18 miles—was



RUNNING GEAR SIDE VIEW

made with an expenditure of 1¾ gallons of fuel oil, and it was shown that the engine could readily start the train on the steepest gradient.

These locomotives are made in three sizes, with either the six-wheel arrangement we illustrate, or with four wheels for services where heavier wheel loading is permissible. They are of 30, 60, and 90 brake horse-power respectively. The 60 H.P. engine is capable of hauling 7 tons up an incline of 1 in 20 at a speed of about 11 miles per hour, and 133 tons on the level, assuming a resistance of 15 lb. per ton, with the engine in top gear, while the hauling power is more than doubled with the low gear. The maximum that can be expected of the big engine is about 400 tons on the level.

Development of Pulverised Fuel for Marine Purposes During 1927-1928*

By CARL J. JEFFERSON (Member), Commander JOSEPH S. EVANS, U.S.N., and Commander JOSEPH BROSHEK, U.S.N. (Visitors).

Foreword.

At the meeting of this Society held one year ago papers were presented in which were given the data of two series of tests on marine boilers using pulverised fuel. The one series, reported by Mr. Stillman, covered the results obtained with a Babcock and Wilcox water-tube marine type boiler, while the report of the other series, which was presented by the authors of this paper, gave the results obtained on a standard three-furnace separate combustion chamber Scotch marine boiler. Since that time considerable further development work has been carried on, and it is the purpose of this paper to enumerate the various phases of the problem which have arisen under actual sea-going conditions and the method of attack that has been employed; also to record the further test plant work that has been carried on during the past year.

Unfortunately, as far as marine boilers are concerned, most of the development work of the past year has been limited to Scotch boilers. The term "unfortunately" is used advisedly, as the advent of higher steam pressures and temperatures with their inherent advantages will probably result in the universal use of water-tube boilers, as Scotch boiler design does not lend itself readily to pressures in excess of 250 lb. per square inch.

The vast amount of experience that has been gathered from shore power plants in reference to the use of pulverised coal with water-tube boilers would possibly make it appear unnecessary to carry on extensive development work with this type of boiler. However, the furnace volume of the sea-going boiler is so much less than that of the shore station that it is unpractical to adopt shore practice for marine use.

The report of the Bayonne tests emphasises the need of further research in connection with the water-tube boiler, especially as to what would be the effect of using various types of water wall furnaces, such as the "direct exposed," the "refractory faced," and the "metal faced" walls. Furthermore, higher rates of evaporation per square foot of heating surface than those shown in the report are necessary.

The present comparatively low price of fuel oil has temporarily removed the chief incentive that prompted the Fuel Conservation Committee of the United States Shipping Board to promote the development of pulverised fuel for marine purposes, albeit this is only a temporary condition, and offers a respite during which the growth of the art will be more thorough than would be the case if working under the forced stimulus of securing an immediate if not completed solution.

Ever since steam was adopted in marine practice, fuel has been the major operating cost. It must be given constant consideration. If fuel be cheap, then the vigilance is apt to be relaxed somewhat. Fuel oil prices have the unhappy habit of fluctuating as much as 100 per cent. Therefore, it is essential that a competitive fuel be available—a fuel that is plentiful, that can be secured at a reasonable price and can be handled with approximately the same ease as liquid fuels. Recognition of this fact not only instituted the initial tests conducted by the two branches of the Government—the U.S. Navy and the U.S. Shipping Board—but has also continued the development, both at the Philadelphia Fuel Oil Test Plant and on board the service laboratory, the ss. "Mercer."

* Society of Naval Architects and Marine Engineers, New York, November 15th and 16th, 1928. Abridged.

SS. "Mercer."

The original installation of pulverised fuel equipment on board the ss. "Mercer" has been described in many of the trade and technical papers. The installation of the pulverised fuel plant and coal bunkers were the only changes made to the vessel. Otherwise, her equipment to-day is just what it was when operated as an oil burner.

Piping Arrangement.—It was desired in making the installation on the ss. "Mercer" to have absolute reliability and such flexibility of arrangement as would take care of any emergency arising from breakdown of equipment. To meet these requirements the original installation was arranged to permit the feeding of any one, two or all three of the boilers with either pulveriser. Also the operation in parallel of the two pulverisers at reduced capacity. Actual operation of this set-up, however, developed a number of difficulties, as the complexity of piping produced an enormous friction load which had to be overcome by the primary air fan. Moreover, it was found most difficult to synchronise the two primary air fans of the mills, so that they would operate in parallel rather than buck each other.

With this set-up any two of the boilers could be comfortably handled by either mill, but attempts to operate the third boiler were unsuccessful, as the primary air fan did not have sufficient capacity at the required discharge pressure to maintain the velocities necessary for keeping the coal in suspension, and the result invariably was plugged burner pipes.

During the trials conducted with arrangement No. 1, it was noted that any two of the boilers could supply all the steam required to operate the vessel at her rated speed. Therefore, as it was desired to expedite the commissioning of the vessel, it was decided, rather than install new primary air fans of sufficient capacity, which would not only involve a delay, but would also mean a continual excessive power consumption by the pulverised fuel equipment, to rearrange the piping.

In the new arrangement the port mill is connected direct through a single distributor to the port boiler, and likewise the starboard mill to the starboard boiler, the centre boiler being dead. It was with this arrangement that the vessel steamed away from the Maryland Dry Dock Company on the afternoon of November 4th, 1927, on the first offshore cruise of a sea-going vessel using pulverised coal as a fuel. This same arrangement was continued in service for the first three Transatlantic voyages, and for the east-bound passage of the fourth voyage. Our observations made on subsequent arrangements and on other installations, force us to the conclusion that for consistent regular operation the arrangement of a pulveriser per boiler is the most satisfactory. Further subdivision of pulverised fuel supply, such as a mill per burner, may prove to have still greater advantages. However, sea-going service tests will be required before a definite statement can be made regarding the merit of a greater number of units, but at least one mill per boiler should be used.

Arrangement No. 2 was not without its disadvantages, and the operating *personnel* decided to modify the installation to permit the firing of pulverised fuel in the centre boiler.

First Voyage, ss. "Mercer"—Operated as Pulverised Coal Burner.

As has been stated, at the time pulverised fuel was installed on the ss. "Mercer," no changes were made in the power plant aside from the actual substitution of pulverised coal firing in lieu of fuel oil. Under these conditions, a reasonable check can be made by comparing her performance as a pulverised coal burner with the best performance obtained when using fuel oil. Such a comparison shows her best oil-burning performance to be a Transatlantic voyage made exactly one year prior to her conversion to pulverised fuel. This voyage was made at a 10·0-knot speed with 10·4 per cent. slip at a mean draught of 18ft., using 270 lb. of fuel oil per mile. If adjustments be made for the ·67-knot lower speed, the 3·53 per cent. greater slippage and the 3ft. 6in. greater mean average draught under which the first pulverised fuel voyage was made, then the fuel per mile factor becomes 280 lb. per mile for the oil burner performance.

In making an economic comparison, the pulverised fuel performance must be charged with an increase in the wage and subsistence item, as shown in Table I.:—

TABLE I.—*Fire-room Personnel for Three-boiler Cargo Vessel.*

	Oil.	Hand-fired coal.	Pulverised fuel.
Number of firemen	3	9	3
Wage per man per month, dollars	65	67·5	67·5
Number of coal passers	0	3	3
Wage per man per month, dollars	0	60	60

Subsistence per man per day, ·60 dollar.

The comparative price of fuel oil and bunker coal will determine just how great or how little is the economic advantage of pulverised fuel as compared to fuel oil.

With oil at 1·80 dollars per barrel, as was the case when plans for the ss. "Mercer" conversion were drawn up, the initial voyage of the ss. "Mercer," made with 5·05 dollar coal, shows approximately 35 per cent. saving in operating cost, but as the price of oil is reduced, the saving is reduced, and when the comparative price of coal and oil reaches the point where 4·8 barrels of 18,300 B.Th.U. oil can be purchased for the same amount as 1 ton of 14,000 B.Th.U. coal, there ceases to be any economic advantage for the pulverised coal.

Ash Deposit, Topside.

During voyage No. 1 considerable ash and soot was deposited on deck, due to the insufficient height of stack. The vessels of the ss. "Mercer" class, in common with the greater part of the war-time built merchant vessels, were fitted with unusually short stacks, the top of the stack barely reaching the deck of the flying bridge. Subsequently, sister ships which were in regular service have had their stacks raised approximately 20ft., but the stack of the "Mercer" had not been modified. Consequently, head winds or winds slightly on either bow caught the ash from the stack, especially when blowing tubes, and carried it down on the deck. At the termination of voyage No. 1 the stack height was increased as much as was possible without changing topping lifts, or approximately 16ft., it still being about 4ft. lower than that of her sister ships. Since elevating the stack, no further trouble from ash deposit on topside has been experienced.

Ash Deposit, Boilers.

While in Rotterdam, furnaces were examined and showed an accumulation of 3in. to 4in. of ash and slag. Four of the furnaces were cleaned, while the deposit was permitted to remain in the other two furnaces. On the vessel's arrival in New York, examination showed approximately the same amount of ash and slag in the four furnaces that were cleaned as was noted in Rotterdam, while the other two furnaces showed approximately 8in. of deposit, made up of alternate 1in. layers of coke and comparatively hard slag. Experience on this and subsequent voyages indicates that furnaces should be cleaned after a maximum of fourteen days' steaming.

Mechanical Troubles.

The initial voyage was made with a large percentage of heavy weather such as is characteristic of the North Atlantic during November and December. The vessel rolling as much as 32 deg. and pitching from 6 deg. to 8 deg. constantly and making occasional dips of 12 deg., gave the installation a real sea-going test and developed certain weaknesses of design which would never be encountered in a shore installation.

Although there were a number of comparatively minor troubles, none of them was so serious but what it could be and was remedied on board. The difficulties experienced consisted chiefly of coupling and bearing troubles, and the cleaning of mill screens, which would become blocked with wood fibre, resulting from pieces of wood entering the mill with the coal and being ground to pulp. Distribution was fairly good when the distributors were operating, but coal leakage along rotor shafts into bearings of the driving turbines caused considerable trouble.

Sea Performance of Pulveriser.

At the time the pulverised fuel plant was installed on the ss. "Mercer," there was a great deal of conjecture as to whether or not the ball mill would function satisfactorily under sea-going conditions, as it was believed by many that the rolling and pitching of the vessel would interfere with the proper cascading of the balls. Actual operation, however, has proven this supposition to be groundless, as numerous samples taken under sea-going conditions not only show as good pulverisation as those obtained at the test plant, but even a finer degree, this probably being due to the fact that the mills in the ss. "Mercer" are operating at a lower percentage of their rated capacity than was the mill at the test plant.

Voyage No. 2.

At the termination of voyage No. 1 the stack was elevated, as noted above.

Dampers were installed to prevent soot deposit in the centre boiler, but these did not prove satisfactory.

Stream-line raw coal feeder casings replaced original casings. This modification assisted materially in securing more constantly uniform feed.

Stationary screens at the mill outlet were substituted for former revolving screens. These proved very satisfactory and eliminated mill shut-downs for purpose of cleaning screens. Overhung primary air fans were installed in lieu of the original fans, with inboard bearing in coal stream.

Voyage No. 3.

New mechanical distributors were installed. These gave good distribution, but were subject to the same fault as the original distributors, namely, coal leakage around the rotor shaft. In this case, however, leakage was into the fire-room instead of into the bearings. A temporary corrective measure was adopted of installing air seal glands and using a small compressor to force leakage away from the bearings. This expedient worked out fairly satisfactory, and the voyage as a whole was a very marked improvement over the second voyage.

Voyage No. 4.

While the "Mercer" was in constant regular service, work was being carried on at the Philadelphia Fuel Oil Test Plant to determine proper corrective measures for the various difficulties experienced on the ss. "Mercer." The chief point of attack was the distribution problem. This research produced a pneumatic distributor, which is described later. As the pneumatic distributor, or rather de-stratifier, had proven itself best suited for universal purposes, it was decided to install three of them in lieu of the mechanical distributors while the vessel was in port prior to sailing on voyage No. 4. This modification proved so satisfactory that on the vessel's arrival in Rotterdam the operating *personnel* rearranged the piping, and the west-bound passage was made with the ss. "Mercer" burning pulverised coal in all three boilers.

Voyage No. 5.

No modifications were made in the equipment between voyage No. 4 and voyage No. 5. The fuel supplied for this voyage, however, was for the first time 100 per cent. slack. Moreover, it had the very low volatile content of 16·6 per cent. The slack coal proved ideal for constant feed, but the low volatile content required considerable attention as to both primary and secondary air conditions, as the pressure carried in both instances had to be much lower than with any of the previous coals used. In fact, the primary air carried had to be reduced to the point where pipe line velocities were barely sufficient to keep the coal in suspension.

This voyage demonstrated the possibility of the pulverised fuel installation employing grades of fuel which

could not be handled in any other way in a Scotch boiler, as with this fuel, inferior both as to size and quality for steaming purposes, the vessel maintained a speed of 10·48 knots.

At the termination of voyage No. 5 it was found necessary to renew the port primary air fan rotor, as the erosive effect of the coal had completely eaten through the three-eighths metal of the fan blades.

Grades of Fuel.

Table II. gives the analysis of the various grades of fuel which have been used for steaming purposes in sea-going service by the ss. "Mercer" during her first six voyages :—

Table II.—*Grades of Fuel Bunkered by ss. "Mercer."*

	Analysis on dry basis.							
	A.	B.	C.	D.	E.	F.	G.	H.
Volatile	16·6	18·8	20·0	20·4	22·8	29·5	29·5	30·35
Fixed carbon ..	73·2	70·8	73·7	72·8	69·45	57·5	62·2	62·55
Ash	10·2	10·4	6·3	6·8	7·75	13·0	8·3	7·10
Sulphur	2·14	1·0	1·4	1·5	1·2	2·4	1·75	1·6
B.Th.U.	14,000	13,250	14,570	14,610	14,440	12,800	14,250	14,425
Ash fusion ..			2,510		2,690	2,350		
Size	100% slack	100% slack	75% slack	75% slack	Run of mine	Run of mine	100% slack	Run of mine

Deductions from ss. "Mercer's" Operation.

The year's operating service of the ss. "Mercer" has brought out several salient points that must be observed in effecting a satisfactory installation of pulverised fuel in Scotch marine boilers, which may be summarised as follows :—

(*a*) Considerably finer pulverisation of fuel is required than that necessary with large refractory lined furnaces, such as found in shore plants.

(*b*) High turbulence of flame is required to produce complete and rapid combustion necessary in the comparatively short flame travel characteristic of a Scotch boiler.

(*c*) Consistently uniform distribution of pulverised fuel between various furnaces of Scotch boiler is necessary to maintain efficient performance.

(*d*) The power plant incident to producing pulverised fuel must be of an economical type, which may be secured either by installation of efficient low water rate units or by useful employment of exhaust if less efficient units be used.

(*e*) Extra precaution must be taken to secure dust-tight smoke-box doors and uptakes; otherwise, when using soot blowers it will be impossible to maintain a satisfactory fire-room condition.

(*f*) The velocities of coal stream throughout cycle requires special consideration to prevent overloading of fans and coal precipitation in pipe lines, and to secure satisfactory selection of superfine grind from mill and turbulence at burner.

(*g*) *Personnel* must be trained to give the same close supervision to "velocity" as is required in regard to viscosity and pressures when using fuel oil.

(*h*) The usual fire-room instruments, such as Orsat and pyrometer, are important, but of greater importance are the draught gauge and smoke indicator.

(*i*) Sized coal, or 100 per cent. slack coal, gives more uniform operating conditions than will run-of-mine; in fact, bunkering with run-of-mine will require use of crushers to produce fuel having a limited maximum size, otherwise feed to mill will be very irregular, a condition that will be reflected throughout the whole operation of boiler plant.

ss. "Lingan."

The second sea-going vessel to be fitted with pulverised fuel is the collier ss. "Lingan," operated by the Dominion Coal Company, Ltd., in their coal trade between Nova Scotia and St. Lawrence River ports. The plant is in many way similar to the original arrangement of the ss. "Mercer," the chief difference being that, in lieu of a main distributor, "Y" branches with adjustable deflectors have been used.

The piping arrangement of the ss. "Lingan," while not giving absolutely satisfactory distribution between the three boilers, has, however, given a workable arrangement that permits operation of the two mills in parallel. The complexity of piping, however, does create a rather severe primary fan load.

The chief objective of the ss. "Lingan" was to develop a mechanical means of firing a type of fuel which has given considerable trouble when used on stokers. This it has successfully done, as the vessel has operated throughout the season using the very high volatile Nova Scotia coal. It was found that the coal in a pulverised form was highly inflammable, and considerable difficulty was at first experienced in preventing the coal from igniting in the burners themselves rather than in the furnace. The difficulty was overcome by modifying the furnace arrangement by moving the combustion ring further into the furnace, and so leaving an exposed water-cooled section of the furnace close to the burner, thereby retarding ignition sufficiently to prevent burning back.

ss. "Stuartstar."*

During the past year the first English installation of pulverised fuel on shipboard has been made. For experimental purposes one single-ended four-furnace Scotch boiler on the ss. "Stuartstar" was fitted with pulverised fuel equipment and operated with pulverised coal on the round trip voyage from England to the River Plate and return—a distance of approximately 13,000 miles, and a total steaming period of about forty-four days.

The results of the trial installation justified extension of the pulverised fuel plant. Therefore, on the vessel's return to England one double-ended eight-furnace boiler was fitted to use pulverised coal. The completion of the second installation gives a 50 per cent. conversion, as the total boiler plant of the ss. "Stuartstar" consists of two single and two double-ended boilers.

A notable feature in connection with the extension programme is that the conversion of the second boiler was completed in seven days. It is also to be noted that this is the first double-ended boiler installation that has been attempted.

* See The Engineer, August 31st and September 7th, 1928.

Summary : Sea Service Tests.

The reliability and safety of pulverised fuel have been thoroughly demonstrated by actual sea operation of the three sea-going installations cited, also by the performance of the tow-boat "Illinois," which has been in operation approximately eighteen months on the Mississippi River. The ability to use satisfactorily fuels which could not be used otherwise in a Scotch marine boiler has likewise been definitely demonstrated. The economic possibilities have been indicated, and the problem in relation to adapting pulverised fuel to marine practice has been crystallised. Real definite progress has been accomplished. However, the final standard type of installation still needs to be worked out. Conversions and new installations now being made will further the development of the art, and aid towards transforming it from an art into a fixed science having definite laws that can be employed with confidence by marine engineers.

Distribution.

One of the most difficult problems encountered in the firing of a three-furnace boiler with pulverised coal similar to the boilers on the "Mercer" and at the fuel oil testing plant has been proper distribution, and a vast amount of time has been devoted to the solution of this problem at the testing plant. It is a comparatively simple matter to convert one stream of coal and air into two equal streams, but when an attempt is made to subdivide into three equal streams, it becomes a real problem. This is largely due to the fact that the mixture of air and coal passing through the single pipe is not homogeneous throughout the length of the pipe or across its section, and the non-uniformity varies with changes in air and coal rates, and also along the length of the pipe. About twenty different types of distributors were made and tried out, and those which presented greatest promise of satisfactory operation were the rifled cone and the pneumatic distributor. The rifled cone had the advantage of requiring no auxiliary power to operate it, but it was not entirely satisfactory throughout the range of rates run. It consists essentially of a truncated cone flanged at each end, so that it can be bolted in the primary piping. In the interior are welded fins or plates in the form of helices, the idea being that as the stream of air and coal passed through the distributor it be given a whirl which breaks up any stream-line properties it might have gained, and that this whirl will continue up to the time it is divided by entering the three feeder pipes. The rifled cone gave excellent results at certain ratings, but is not entirely satisfactory throughout the range of rates at which it is desired to run.

The pneumatic distributor was finally decided upon as the best developed for universal service to date, and, as previously stated, this has been installed on the ss. "Mercer." This distributor is very simple, and embodies the principle of the rifled cone in that it imparts a whirl to the coal and air stream, but has the added advantage of permitting adjustment for various rates and conditions. It consists of a circular disc, the inside diameter of which corresponds to the diameter of the pipe, and through which are drilled tangential orifices connected to a course of compressed air. When air is turned on, it forms a whirl on the inside, and has the effect of imparting a spiral flow to the coal stream. By varying the pressures in the orifices the stream of coal and air can be spiraled so as to give equal flow through each of the three feeder pipes. The main objection to this type of distributor is, of course, the fact that an external source of auxiliary air supply is required. The problem of satisfactory distribution is not yet solved, and considerably more work will have to be done on it.

The Blo-Gun.

It will be noted in reference to the aforementioned record of voyage No. 5 of the ss. "Mercer," that at its termination it was necessary to renew the fan rotor and section of fan casing, due to erosive effect produced by the pulverised coal passing through the fan. Early in the operation of the ss. "Mercer," it became apparent that consideration must be given to the correction of this operating difficulty, as the effect of fan blade erosion extends beyond the fan itself, inasmuch as erosion is not uniform and an unbalanced high-speed fan quickly sets up vibrations which may prove very serious to the fan drive.

There are several methods of attacking this problem, as, for example :—

(*a*) Use of a forced draught instead of induced draught for the air sweeping the mill. This method is now employed by several pulveriser manufacturers, and is fairly satisfactory. However, it has a tendency to create turbulence in the mill which militates somewhat against classification of superfines by air current.

(*b*) Use of special materials for manufacture of fan blades.

Considerable experimental work has been conducted along this line, which has resulted in varying success under different conditions. Up to date, ordinary soft iron has, however, given the best universal service. At present a fan fitted with chrome-plated blades is being tried out on the ss. "Mercer," but a definite statement regarding results cannot be made at this time, as the fan has not yet been subjected to a long enough period of service.

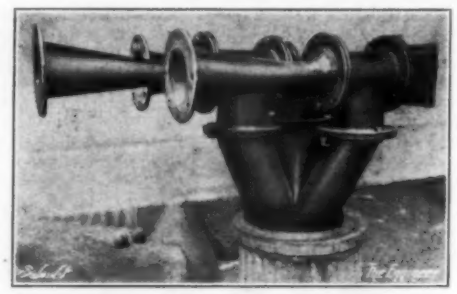
(*c*) Use of comparatively cheap and easily renewed rotor.

A number of shore plants have adopted this compromise method, but it cannot be accepted as satisfactory, as it interferes with continuous operation, such as must be maintained by the sea-going installation.

(*d*) A fourth method is to apply the ejector principle, which has been attempted at the test plant by the use of the so-called Blo-Gun. The original idea was to have a single ejector nozzle operating on outlet of mill and discharging to a distributor head. It was decided, however, to attempt to not only work out fan erosion, but also distribution with the same device.

The Blo-Gun as finally built is shown below.

The principle of the device is to create a partial vacuum by means of a high velocity air current discharging from a nozzle across an enlarged chamber into a venturi throat. The partial vacuum sets up an air current which sweeps through the pulveriser, picking up the finely pulverised fuel and carrying it into the mixing chamber, where it joins with the stream of injection air and forms the total primary air and coal mixture going to the burner.



The Blo-Gun

The injection air or fan discharge is the carrier air which is known as the β air. The induced air from the mill which sweeps out the pulverised fuel is known as the α air. The combination of α and β air is the primary air of combustion. The device must be set up close to the mill discharge, as long leads will either create so great a friction that the β air cannot create sufficient vacuum to maintain an induced air circuit or else, in order to overcome friction, the pipe areas will be so large that sufficient velocity will not be maintained to keep the coal in suspension.

Furthermore, the β air, which is of approximately the same proportion to the total primary air as is the carrier air usually induced between the mill and primary air fan precludes the admission of additional carrier air, such as would be required if connections be removed from close proximity to the mill discharge, as additional air would produce too lean a mixture for satisfactory combustion.

Service tests with the Blo-Gun direct connected to the mill have not yet been conducted, but quantitative values of α and β air have been determined by measuring the flow from fan and the induced air by means of orifices. The Blo-Gun requires service tests to determine its real merit. It has been included in this record, however, as it is a new method of attacking one of the serious problems characteristic of pulverised fuel.

Conclusion.

The possibility of efficient, reliable and safe operation of marine boilers with pulverised fuel is no longer a hypothesis. It is an established fact demonstrated by actual operation, both under test plant and sea service conditions. The impression that pulverised fuel has entirely passed out of the experimental stage, however, must be avoided, for such is not the case. For some of the marine trade routes pulverised fuel can, in its present state of development, be adopted with every assurance of satisfactory results, but in others the application must still be considered an experiment.

Service tests of the various available low-grade bunker fuels are required to determine their economic merits.

The programme at the test plant calls for tests of several mills and burners other than those that have been employed to date, in addition to further tests on the equipment mentioned in this paper.

The principles governing the selection of equipment to be used in the future tests are :—

(*a*) Simplicity of construction and operation, which is generally accompanied by reduced first cost.

(*b*) Low power consumption, in order that improved boiler efficiency be not offset by increased auxiliary load.

(*c*) Reduced floor space, so that equipment can be installed without making structural modifications.

There are certain basic facts regarding pulverised fuel which should be determined, the establishment of which can best be handled by a research rather than a development programme. The main items that require such treatment are :—

(*a*) The pulverised fuel carrying capacity of air under varying temperatures, humidity and velocity conditions for the varying degrees of fineness of the fuel.

(*b*) The establishment of a standard method of determining "grindability" of various fuels.

(*c*) A survey of the various bunker fuels of the world to determine their grindability.

The determination of these basic facts is of such vital importance to the development of the art that the research programme should be sponsored by all the allied interests connected with the production, preparation, and consumption of solid fuels. These include fuel producers, distributors, manufacturers of equipment, shipowners, and operators.

Much of the pioneer work has been accomplished by the Government. It now devolves upon the private interests to carry on.

A year ago this time, the American Merchant Marine had just taken its first step towards actual application of pulverised fuel to marine purposes. The rest of the world looked on, interested but not convinced.

The situation is at present somewhat changed. The necessity of making use of their natural resources has

stimulated the efforts of the engineers abroad, so that instead of being only spectators they have become very active participants in the development of pulverised fuel for sea service, and to-day our former position as leaders in the art is being seriously challenged.

Textile Machinery Exhibition at Manchester.

THE eighth of a series of annual exhibitions devoted to textile machinery and accessories is being held this week at the City Hall, Manchester. Of the seven previous exhibitions four have been held in Manchester, two in Leicester, and one in Scotland; but the present one is claimed to be the largest and most comprehensive of the series. There are nearly 200 exhibitors hailing from Great Britain, France, Germany, Switzerland, and Czecho-Slovakia, and much of the machinery is shown in operation, the power being supplied from the Manchester Corporation electricity mains. Machinery for dealing with silk, as is only to be expected, forms a prominent feature of the exhibition. It seems rather singular that amongst all the cotton spinning machinery on view there is not a single mule, for the mule is unequalled for the production of good yarn, and Great Britain still leads the world in mule spinning.

Amongst new looms there are two of continental production which call for special mention: the Souczek, made by Eisenwerke Sandau Aktiengesellschaft, Prag Smichov, Czecho-Slovakia; and a silk loom for crêpe de chine, by Ateliers Diederichs, Burgoin, France. The Souczek loom has a friction picking motion. At each side of the sley and in front of the shuttle box there is a rapidly rotating friction disc, the position of which, either below or slightly above the shuttle race, is controlled by an automatic motion. The left-hand disc revolves clockwise and the right-hand disc in the anti-clockwise direction. At the end of the shuttle box at each side instead of the picker a leather strap is provided, which acts as a bowstring fastened at the ends and is kept in tension by strong springs. The makers claim that, besides giving a continuous uniform motion, this loom avoids wear and breakages. The silk loom to which we have referred has a sley with a two-shuttle drop-box motion, on one side controlled by a positive motion which gives two picks from each box alternately. The shuttle boxes are fitted with an automatic motion for the retention and release of the picker and the shuttle, permitting accurate tension of the weft. The loom has a three-roller take-up motion, which allows the fabric to be examined or cut off without stopping the loom. The first roller is covered with emery, the second roller is cloth covered, and the cloth is wound on the third roller under negative control. A loose reed motion giving excellence of cover and evenness of fabric is fitted. All the parts are interchangeable.

Whittaker Automatic Looms, Ltd., Preston, shows looms by several makers fitted with its patented automatic weft replenishing device. With this appliance the spent cop is ejected within a fraction of a second, another is inserted and the shuttle is threaded without pause or loss of speed. One of the looms is fitted with a magazine which holds twelve shuttles, which are fed to the loom as required. This arrangement should reduce the amount of labour required to operate the machines very greatly. Another loom deserving of special mention is that shown by Gawsworth Patents, Ltd., Aytoun-street, Manchester. This is fitted with a self-weaving attachment which can be applied to existing types of looms except those of the multiple-box style. The essential feature of the attachment is that it enables continuous weaving from two "cheeses" mounted at the back of the loom. It comprises means for guiding the weft from an endless supply, a pair of weft clipping and severing devices which co-act with means for drawing out a correct length of weft into a loop, and a weft carrier for conveying the individual lengths of each loop through the warp shed. The clips and weft cutting mechanism are automatically operated to hold, release and cut the weft as required in proper sequence. The weft carrier is self threading and is propelled to and fro like an ordinary shuttle.

Textile Accessories, Ltd., Parsonage, Manchester, shows a Benninger four-shuttle change-box loom for the manufacture of silk, artificial silk and half-silk cloths. It has a precision differential take-up motion for direct or indirect rolling up with a compensating clutch, special connecting arms, and an accessory crank fitted with the drop box side knock-off motion to remove danger of the loom frame being broken. The change motion is operated by a dobby, a strong brake band on the driving side, a movable breast board roller and lateral weft stop motion. The loom is fitted with special shuttles for wood pirns in connection with a new pirn weft stop motion device whereby the loom is automatically stopped before the last few yards are exhausted from the pirn.

Amongst the preparation machinery shown, Platt Bros. and Co., Ltd., Oldham, have a carding engine for artificial silk which has revolving flats specially designed for cut staple fibre. The flats have a reverse direction of movement and a special roller stripping device to return the "strip" to the cylinder for blending with incoming material. The wire covered stripper partially clears the flats of fibre and the brush stripper completes the process, the brush in turn being cleared by the wire stripper and the latter by the cylinder. Platt Brothers also show a new ring spinning frame fitted with four different systems for high draft spinning namely, the "C.S. and L." system with a flexible leather covered roller; the Toennissen system of weighting with the first and third lines of rollers leather covered and dead weighted; an arrangement with loose boss stop roller for the second line; and an arrangement with a hollow steel top roller for the second line. All the systems have four rows of rollers. The spindles are driven by tapes from one tin roller, four being driven by one tape over jockey pulleys and the thread lappets rise and fall with the build of the cop, being controlled by the rocking shaft.

Dobson and Barlow, Ltd., Bolton, are showing the most modern types of artificial silk and cotton spinning machinery. In the new centrifugal spinning machine for artificial silk the traverse is divided into sections, the rise and fall of which do not synchronise, but follow each other, and by this means it is claimed that an even strain and perfectly balanced shaft are obtained. The machine is driven direct through gears by an electric motor. All the parts in contact with acid are made of "Bakelite," and ventilation is provided by means of a hood which connects above the godet rollers and from the centre of the machine to the spinning boxes. A bleaching machine for artificial silk is shown in which the combined processes of desulphiding, washing, bleaching, souring, washing and soaping the skeins of silk are carried out. Winding and gassing frames are shown by Joseph Stubbs, Ltd., Manchester, and Arundel Coulthard and Co., Ltd., Preston. A new model of the Nasmith comber is shown by John Hetherington and Sons, Ltd., Manchester, working under mill conditions with Sakel cotton. In this new machine the movements of nearly all the parts is much reduced, and the movements are much more silent than formerly. Altogether the machine is simpler and more accessible.

Thomas Broadbent and Sons, Ltd., Huddersfield, exhibit a 48in. hydro-extractor which is direct driven by an electric motor without the intervention of a clutch. All parts of the machine are above the floor level and the only foundation required is a bed of concrete. J. W. and H. Platt, Bouverie-road, Harrow, Middlesex, exhibit a card to which is applied a new metallic clothing made from a strip of steel $^1/_{80}$in. thick. The clothing has rigid needle points like saw-tooth wire, but finer, making the number of points per square inch approximately equal to ordinary flexible fillet. The teeth are without "knee," conical in shape, and are of hardened and tempered steel, the angle of the teeth combined with the rigidity giving remarkable results.

Sir James Farmer, Norton and Co., Ltd., Manchester, are exhibiting a chainless mercerising machine, a hank dyeing machine and a new hydraulic jigging motion for stentering machines. The mercerising machine consists of one or two saturating mangles, a hydraulic length tension regulator, a series of special expanders and a counter-current washing system. After passing through the above parts the cloth is plaited down or passed through a "matter" recuperator and is washed and soured in the usual way. The advantages claimed for this machine are improved impregnation, uniform stretching of warp and weft, and exact control of the tension.

In the accessories section of the exhibition we noticed a running exhibit made by P.I.V. Chain Gears, Ltd., 7, Prince's-street, Westminster. This ingenious variable gear drive consists in the use of a short chain of special construction operating between two expanding pulleys of the opposite conical disc type and mounted on shafts. The inner working faces of the two expanding pulleys have alternate ribs and grooves which radiate from the centre forming teeth which engage the chain. When it is desired to alter the speed ratio between the two shafts all that is necessary is to slide, by means of a lever, the two halves of each of the expanding pulleys along their shafts. When the two halves of one pulley are brought closer together the chain, being of fixed width, rises automatically in the V, thus making a pulley of large diameter; while, on the other hand, when the other pulley faces are widened out the chain falls in the V, giving the equivalent of a smaller diameter. A feature of novelty is the manner of constructing the chain, which is built on the lines of an ordinary power chain with links and rivets, but in each link between the rivets is a longitudinal slot which is filled with closely packed steel slats. These extend from side to side of the chain, the ends projecting in order to enable them to engage with the pulley faces. The whole of the mechanism runs in oil and is quite silent. Other exhibitors of general engineering interest are Bolton's Superheater and Pipe Works, Ltd., and Victory Valves, Ltd., Stockport. The products of these firms are already familiar to readers of this journal. The steel valves have wrought steel bodies with detachable sleeves which carry the valve seatings, and the seatings are made of a very hard alloy called "Vicro-metal." On the same stand we noted an exhibit of Rhodes, Brydon and Youatt, Ltd., Stockport, comprising a very neat self-contained electric motor and rotary pump of very simple design called the "Mopump." These pumps are designed to lift up to 100ft. head and are made of iron, gun-metal, stainless steel or lined with vulcanite.

The New International Association for Testing Materials.

SOME months ago a British Committee, consisting of representatives of some of the most important Engineering and Technical Societies and Institutions of this country, was formed for the purpose of arranging British participation in the New International Association for Testing Materials which has been established as a result of the Amsterdam Congress of last year. This Committee has recently issued an appeal to members of its constituent societies to join the New International Association. Quite recently also the Permanent Committee of the New International Association held its second meeting in Paris—June 21st—and has arrived at a number of important decisions affecting the future conduct of the Association and its Congresses. A brief statement of the present position and activities of the Association may therefore be of interest.

According to the Statutes adopted at the Congress of Amsterdam in September, 1927, the main object of the New International Association is to hold periodical Congresses, and the Permanent Committee has accordingly devoted its attention almost exclusively to that question. Experience of past Congresses, both at Amsterdam last year and the earlier gatherings of the old International Testing Association, has led to the conviction that it is unsatisfactory at a single Congress to discuss subjects covering the whole range of the testing of materials, and that it is necessary, if a satisfactory and fruitful discussion of pressing problems is to be facilitated at a Congress, to confine attention to a relatively small number of subjects in each of the sections into which the work of the Congress is to be divided. In the latter respect important decisions were taken at the Zurich meeting of the Permanent Committee held in January last, when it was decided to divide the work of the Congress into four sections, namely:—Section A, Metals; Section B, Inorganic Non-metallic Materials (Cement, Concrete, &c.); Section C, Organic Materials (Oils, Paints, India-rubber, &c.); and Section D, General Methods of Testing. While making this subdivision of subjects, it is the view of the Permanent Committee that undue specialisation in the treatment of important questions by international discussion is essentially undesirable, and that, as far as circumstances permit, the meetings of the four sections of the Congress should not overlap except where very highly specialised points are under discussion. Such an arrangement will enable members participating in the Congress to hear reports and discussions on matters in other sections besides those in which they are personally most immediately concerned. It has been strongly urged that the methods of testing used for one class of material are often of interest and importance in connection with other types. For example, it has been suggested recently that the methods used for the testing of textile fibres resemble very closely those used for the testing of metals, and that comparison of these methods would be instructive for all concerned. In this connection the activities of Section D of the Congress should be particularly valuable, since they will facilitate the general discussion of testing methods rather than of individual materials.

Having adopted the principle of confining the discussions to be held at any individual Congress to a small number of specially important subjects, the Permanent Committee is faced with the difficult task of selecting the particular subjects in each group which are to be reported upon and discussed at the next Congress. With a view to providing ample time for the preparation of reports and discussions, although the next Congress is not to be held until 1931—at Zurich—the Permanent Committee in January last issued an invitation to all the participating countries to forward suggestions for subjects for discussion to be considered by the Permanent Committee at their meeting in June. This invitation provoked a very lively response from sixteen countries. A very large number of suggested subjects were put forward and these had to be carefully sifted at a preliminary meeting of the Chairman of the four groups of the Association which preceded the meeting of the General Committee in Paris last month. Since suggestions ranging in number from forty to sixty had been received for each of the four groups, it appeared impossible to make an immediate choice of only four or five subjects for each group for definite discussion at the Zurich Congress of 1931. It was therefore decided to adopt an intermediate stage which would, at the same time, serve to keep alive the activities of the Association and to achieve its principal object of maintaining and facilitating international exchange of ideas and experiences in regard to the testing of materials.

An invitation is accordingly about to be issued, through the delegates of participating countries who are members of the Permanent Committee, inviting each country to prepare a number of preliminary summarising reports on a small number of selected subjects. Out of the long list of suggestions which were before the Permanent Committee in Paris, a selection has been made of about ten subject headings with a few sub-headings for each of the groups. A list of these headings is being sent to each country and the local Testing Association or equivalent organisation is being invited to select a few of these subjects and to appoint reporters for the purpose of preparing the preliminary reports for which the Permanent Committee has asked. While these preliminary reports are intended to serve essentially as a basis for the final selection of subjects and reporters for the Zurich Congress in 1931, it is proposed to publish these preliminary reports, since they will constitute a valuable collection of data and opinions on important questions relating to the work of the New International Association. This publication will, it is hoped, be possible early in 1930. Each of the reports will be published in one of the official languages of the Congress—English, French, and German—but it will be open to any nationality to have its own reports printed also in its own language, provided that the National Organisation in such a case bears the additional expense entailed. When, towards the end of 1929, the Permanent Committee has before it the whole of these preliminary reports, it will be in a better position to consider the final selection of subjects and of those who may be invited to prepare Congress reports upon them. These Congress reports, again, will be circulated to members intending to take part in the Congress, so that the whole of the time of the Congress itself can be devoted to free international discussion of the questions treated.

It will be seen that the International Association is adopting a difficult and laborious course of preparation for the work of the Congress of 1931, and it is hoped that the results achieved by that Congress will justify the amount of time and trouble thus devoted to its preparation. In the past, the activities and interests at International Congresses of this kind have been too widely scattered over a great range of subjects, each of which has had to be hurriedly and inadequately treated in discussion. By the process of the preparation of preliminary reports and a careful subsequent sifting of subjects and the selection of those most likely to be of general interest and importance it is hoped to avoid this scattering and to achieve a thoroughly satisfactory discussion of a limited range of subjects.

With regard to British participation in the work of the New International Association for Testing Materials, it may be mentioned that the British Committee is taking active steps to secure widespread membership among those interested in the testing of materials in this country. A full series of suggested subjects was submitted from this country to the meeting of the Permanent Committee in Paris in June, and some of the suggested subjects have been included in the selected list for preliminary reports. It is anticipated that a number of subjects will be selected by the British Committee for report by British experts, so that this country should be adequately represented when these reports are published by the International Association.

AT a meeting of the Council of the Society of Motor Manufacturers and Traders, Ltd., held on Thursday, November 15th, it was decided that the Motor Show in 1929 shall be held from October 17th to 26th.

A Wheel Lathe Electric Control Panel.

THE electric control panel shown in Fig. 1 was exhibited by the Watford Electric and Manufacturing Company, of Whippendell-road, Watford, at the recent Machine Tool Exhibition at Olympia. It has been specially designed for use in railway shops, and it can be mounted in close proximity to a machine tool, for it is totally enclosed and well ventilated. It has glazed hinged doors, and a removable back. The doors are interlocked with the isolating switch, which must be opened before the doors can be opened, the isolating switch being contained in a separate inner chamber provided with a lock and key. When the main doors are opened, all the internal parts are therefore

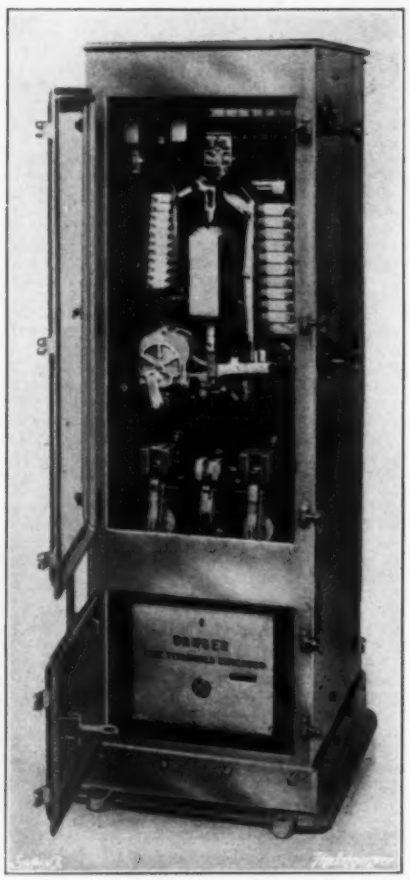


FIG. 1—WHEEL LATHE ELECTRIC CONTROL PANEL

"dead." Similarly, before the isolating switch can be closed again, in order to make the gear operative, the doors of the panel must first be closed, so that under all conditions the panel is fool-proof.

The design of the panel embodies protection against overloads on the motor, and gives double-pole operation by two main contactors having a powerful magnetic blow-out on each pole. No-volt release is also provided. A feature of the contactors is the maker's patented three-point lock, consisting of a butt and brush contact, the former being used for making and breaking the circuit, and the latter to carry the full-load current continuously and for short-circuiting the blow-out coil, thereby reducing the rating of the coil and permitting a more powerful blow-out effect to be obtained. The coil is only inserted in the circuit during the time the contactor is closing or opening, and after the brush contact has opened and the current is being carried by the butt contacts. The design obviates chattering at the time of closing, which has been a serious disadvantage of contactors working either with alternating or direct current, the whole of the wear and tear on such contactors taking place at the time of closing, and not on opening the circuit; a fact which the makers of this panel contend has not in the past been understood by operators of control gear, or, in fact, by many manufacturers.

To ensure a very powerful blow-out effect, the magnetic pole pieces are set into the arc shields, so as to ensure a very small air gap just where the flux is required to dissipate the arc when the butt contacts are interrupting the circuit.

Another noteworthy feature of the design is that no springs are used to give the pressure on the contacts, which is obtained by the moving member being pivoted above a central pin, the pressure being provided by the butt contact on one side of this centre pin and the brush contact on the other, thereby ensuring a good contact irrespective of a spring employed to keep the contacts forward, where the circuit is made and broken, and so that the brush contact makes circuit last and leaves its stationary contact first. These contactors are used for inching and making and breaking the circuit when starting and stopping, and they work in conjunction with a patented rheostat which accelerates the motor very smoothly in eleven starting steps by means of a bar which is moved in an upward and outward direction on to carbons flexibly supported by means of springs in white metal die-cast holders, to which the resistance leads are connected.

The rheostat bar is designed so that whilst the resistance is being cut out of circuit, a full-face contact is obtained on each carbon, as sections of the resistance are short-circuited, thereby eliminating sparking on the contacts, whilst a rubbing and self-cleaning action maintains these carbons at right angles to the bar and any carbon dust which may be rubbed off falls freely away when the bar returns to the off position. After the armature resistance has been short-circuited on the last carbon, a laminated brush contact is closed, and short circuits the resistance entirely. The main solenoid also actuates a similar bar, which inserts resistance in the motor field up to the point set by the shunt regulator, and this bar short circuits the whole of the shunt field resistance during the starting period; it then moves away from the carbons and inserts resistance in the field circuit in eleven steps, thus gradually accelerating the motor up to the desired speed, for which the shunt regulator is set. This method of inserting the shunt resistance is a definite one, and does not depend upon the very close setting normally required with a trembling relay, which the company has now abandoned.

The cutting-out time of the starting resistance and that for inserting the shunt resistance is fixed by an eddy drag retarding device, consisting of a train of wheels attached to the sector which carries the rheostat bar, and it drives an aluminium disc between the poles of an electro-magnet. The eddy currents set up in the disc as the result of it cutting the flux, reacts on the flux and gives the requisite slow motion for cutting out the armature resistance and for inserting the field resistance, and by simply moving one of the pole pieces so as to increase the air gap, the speed of operation of the mechanism can be adjusted over a wide range. The retarder coil is connected in series with the motor armature, and when the motor is starting against a heavy load, the abnormal current in the coil produces a more powerful flux and the motor consequently starts more slowly than it does when starting against a light load. The retard coil is cut out of the armature circuit when the last step of the starting resistance is reached, so that it does not carry current whilst the motor is at work.

In the case of the panel exhibited at Olympia, the shunt regulator motor was controlled by push buttons, which can be mounted at the lathe end, so as to enable the operator to accelerate or declerate the motor from that position. An additional button in the control box, or, if preferred, in a separate housing, is provided to enable the operator to avoid spoiling the tool when hard spots are met with in wheels that have been subjected to heavy braking. When a hard spot is approaching the

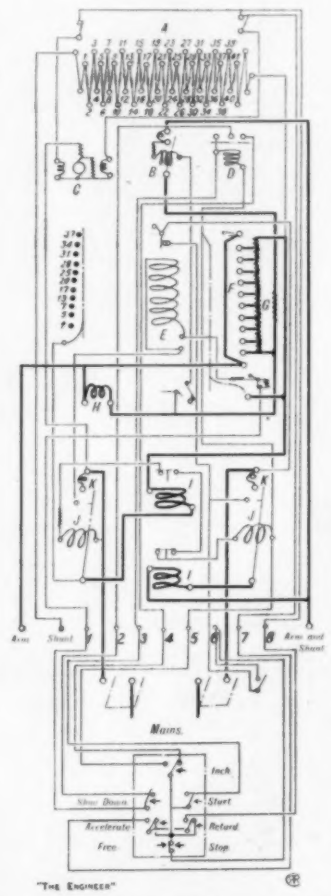


FIG. 2—CONNECTIONS OF CONTROL PANEL

tool, the operator presses the slow-down button, which short-circuits the shunt field resistance, inserts armature resistance and closes a diverter contactor across the armature, so that the motor is slowed down to a speed which permits the tool to cut into the steel at the hard spot without spoiling the cutting edge, and immediately the hard spot has passed the tool, the operator takes his finger off the push button and the motor quickly accelerates again to the normal cutting speed, which is determined by the setting of the shunt regulator.

The diagram of connections for one of these control panels is shown in Fig. 2, where A is the shunt regulating resistance, B the diverter contactor coil, C the shunt regulator motor, D the "slow" relay, E the rheostat operating coil, F the main rheostat resistance, G the diverter resistance, H the retarder coil, I overload coils, J main contactor coils, and K blow-out coils. These control equipments, we understand, are in use in a considerable number of railway workshops, and the manufacturers have a number under construction for use with other wheel lathes.

Another control panel for use with wheel lathes, but designed for controlling a slip-ring induction motor, was also shown at Olympia. The control box is designed on the same lines as that associated with the direct-current pillar, and has "Accelerate," "Decelerate," "Slow down," and "Stop" push buttons. The operation in this case is dependent upon rotor resistance control provided for by a three-phase rotor rheostat. The panel is designed to give a speed reduction of 60 per cent. below the full speed.

South African Engineering Notes.

Air Cooler for Deep Mines.

INFORMATION from the Rand indicates that the solution of the problem of working in high temperatures in the deep level mines of the Rand seems now in sight, owing to the successful research work done by some of our leading engineers. The invention in question is a portable air cooler which claims to be an economic solution of the difficulties met with in a hot, humid atmosphere.

The principles involved are:—(1) The compression of warm, saturated mine air sucked into the machine from any section of the mine; (2) the cooling of the compressed air to about the initial temperature by circulating mine water; (3) the extraction of the moisture condensed during the cooling process whilst at high pressure; (4) the expansion of the high pressure air in an air motor so that a low final temperature is obtained, and the dry air discharged to working places. The power developed by the air motor is utilised to assist in driving the compressor; (5) reheating the cold expanded air by stages, so as to prevent troubles due to very low temperatures and to reduce the power consumption by utilising the circulating water passing from the coolers during or after compression of air; (6) the balance of power required to drive the compressor not furnished by the air motor, and making up frictional and other losses to be supplied by an electric motor. Such a machine as herein outlined has not yet been built, but it seems to offer a plausible and possible solution of the heat and humidity problem in ultra deep level mining.

Great Copper Field.

That portion of the Belgian Congo containing the copper mines belonging to the Union Minière du Haut Katanga, together with that portion of Northern Rhodesia which borders on the Belgian Congo and extends down south past the Bwana M'Kubwa copper company's mines at that place and N'Kana, appear destined to become the world's greatest copper field. The operations of the Union Minière continue to show steady progression, the output for the current year being expected to be about 115,000 tons of copper. The production for the last financial year totalled 90,000 tons, which realised an average price of £55 13s. per ton. With increased output, costs are falling, while the value of copper is increasing. The construction of the first unit of the leaching plant was being rapidly pushed forward, and it should be in operation by the end of 1929. It will have an annual capacity of 30,000 tons of copper, and will be worked by steam power at first and later by electric power from the Lufira Falls, the works in connection with which are well in hand, and should be completed by the end of 1930. The power from that source will also be utilised for the two additional leaching units which it is proposed to erect, probably on the Western Mines. With the opening of the Western Mines a new stage of development will commence, because, when the Benguella route is completed and hydro-electric power and leaching are available, the Union Minière will be able to treat a much lower average grade of ore, and produce the cheapest copper in the world. The copper ore developed at the present time is estimated to contain metallic copper to the value of £300,000,000, and that by no means represents the whole of the company's resources. Only recently they have absorbed a further area of high grade ore, while they have enormous quantities of ore which, in comparison with any other than the exceptionally rich ores they are at present working, would eclipse all except some of the best results recently being obtained in depth at the N'Kana Mine.

Judging from recent developments the N'Kana Mine of the Bwana M'Kubwa copper is likely to prove a huge tonnage mine of well above average grade for the world's really big copper mines. From 13,000,000 to 17,000,000 tons of ore may be said to be already proved. The percentage of copper from the assays seemed at one time to point to a grade of about 4 per cent., but for some time now the results have been improving, and as high as 6 per cent. has been obtained.

With regard to the Roan Antelope Mine, a huge constructional and development programme is now being initiated by the company. The scheme involves an expenditure of no less than four million pounds sterling during the next two or three years. When the scheme is completed, the Roan Antelope will become the most important individual copper mine in Africa, and will take high rank in the list of the biggest copper producers of the world. A crushing and treatment plant of 5000 tons per day capacity, together with a large smelter is now being designed in London, and constructional work is to start almost immediately. The grade of the ore at the Roan Antelope has been estimated at from 3·5 per cent. upwards, so that the output of the mine should, when operating on the basis stated above—say, 1,500,000 tons per annum—be not less than 50,000 tons of metal per year. American interests are becoming more and more impressed with the possibilities of Northern Rhodesia, and have succeeded in getting much capital invested in the mines there already. During the last year they have obtained a controlling interest in the Roan Antelope, which is to be regretted, as it means that not only are American experts being employed, but that a large proportion of the plant required to equip the mine will be American.

Time alone, of course, can show how accurate the supposition that these two mines, the Roan Antelope and the N'Kana–Bwana M'Kubwa are destined, in the not far distant future, to have a combined output that will fall little short of 100,000 tons of copper per annum. Placing a value of £60 per ton of metal on this production, it will

be evident that from these two mines alone Northern Rhodesia may reasonably hope, in the not far distant future, to have a mineral output worth more than the present value of the entire mineral production of Southern Rhodesia.

Bridging the Benue River.

What it is claimed will be the longest bridge in the African Continent is now in course of construction in Nigeria, across the Benue River, at Makurdi, some 300 miles from Port Harcourt. The bridge will be an important link in the Nigerian Eastern Railway system. Hitherto traffic has been carried across the river by a train-ferry. The structure is being built by Sir William Arrol and Co., of Glasgow, the contract price being £960,595. The total length between the abutments will be 2584ft. There will be thirteen spans. The weight of steel work in the bridge exceeds 8000 tons. It is estimated that it will take four and a-half years to complete the work.

Congella Power Station.

The new power station at Congella (Durban, Natal) has started work, though it is not expected to be in regular commercial operation just yet. Arrangements are being made for a regular supply of special coal for pulverising. When the station is in full working order, the local municipal station will be relieved of a large portion of its present heavy load, and whereas it has carried as much as 21,000 kilowatts, the load will, in future, not exceed 6000 kilowatts. The new power station has been established by the Electricity Supply Commission.

Union Railways.

Some striking facts and figures, regarding the Union Railways, have recently been published. At the end of 1909 the total mileage was 6894, while the mileage figure at December 31st, 1927, was 13,028, and it must be borne in mind that over 7000 miles of road motor services are now being operated in addition to the railroad. Thus it may be said that the total transportation mileage has been almost trebled in the course of eighteen years. Passengers carried in 1909 numbered 28,191,135, the total in 1927 being 81,113,229, whilst revenue-earning goods traffic increased from 8,935,466 tons to 20,775,744 tons over the same period. In fact, by the end of 1927 passenger and goods traffic had increased in such a measure as to tax the organisation of the Administration to the fullest extent. To meet these circumstances many ambitious improvements in haulage power had been provided in the form of high-powered locomotives, whilst over a section of nearly 200 miles of the Natal main line, where the coal traffic was at its heaviest, electric traction had been introduced and the general provision of more capacious rolling stock and heavier metals for the permanent way had been effected.

Pretoria Water Scheme.

Government approval has been given to the Pretoria water scheme, which was finally decided upon by the Town Council. The scheme is known as the Rietvallei scheme, and will augment the Pretoria water supply from the Fountain by a minimum of 2,000,000 gallons per day. The cost of the water rights involved is £200,000, plus 5 per cent. commission, and the cost of the scheme plus storage will be about £500,000. The Government has also agreed to the building of a storage dam. The capacity of the dam will be 511 million cubic feet, and the water will be brought to Pretoria entirely by gravitation.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Conditions.

THERE appears to be a brighter outlook for the basic industries of the Midlands and Staffordshire, but any improvement there may have been up to the present has been insufficient to have appreciable effect upon the iron and steel market. Even the German labour trouble has had little influence on the Midland market, and though there is less foreign material on offer, it does not appear that an equivalently increased amount of business is being given to local producers. It is true that some of the makers of billets and small bars are better circumstanced, but it had been anticipated that ere this there would have been an urgent call for native half-products to take the place of unavailable imported material. Native values remain where they were a fortnight ago, which indicates that whatever increased demand there may have been it has not been such as to justify makers assuming they could get better prices. Apart from the steel department, there is little to interest traders. Iron, raw and finished alike, sells slowly at recent rates, and the market generally pursues a very even and undisturbed course.

Steel.

Finished steel is in quiet request, and values are stationary. Constructional engineers in this area are fairly employed and call for regular, if small, tonnages of angles and joists. They complain of the keenness of competition, which compels them to accept work on a very small margin of profit. The plate mills are unable to dispose of their output. Rolling stock works building the new 20-ton all-steel wagons are taking a very useful tonnage, but a recovery in consumption at the shipyards is much needed to ensure healthy conditions at the plate mills. Boilermakers in the Midlands are moderately engaged, and are absorbing a fair amount of material. Ship, bridge and tank plates, ¾in. and over, make £8 12s. 6d., and boiler plates £11. Makers of billets and small bars are doing rather better, but they are not adding to their order books to the extent which might have been expected under existing conditions. Offers of continental supplies have become rare, but there does not appear to be any market stringency. Deliveries of imported semis are very little behind, and though consumers here expressed some anxiety as to the probability of orders placed now being delayed, they are not, generally speaking, covering themselves by buying British. This does not apply, however, to special steels, such as are used by the motor engineering industry. For this class of material there is, at date, a strong demand. Prices of mild steel billets are unchanged at £6 7s. 6d. to £6 10s., but prices of small rolled bars vary considerably according to date of delivery. In some cases in which a few tons have been urgently wanted as much as £8 10s. is reported to have been paid. Orders for forward delivery are accepted at from £7 15s. to £8. Steel scrap is in moderately good demand at recent rates.

Raw Iron.

Unsatisfactory trading conditions still exist in the pig iron department in this district. Orders are scarce and of small content, while prices, though quotably unchanged, have a tendency to weakness. It is considered certain that an order for bulk supplies could be placed at below current rates either with Northamptonshire or Derbyshire smelters. Although there has been a curtailment of output owing to the breaking down of a Derbyshire furnace and the blowing out of one in Nottinghamshire, there has been no appreciable shortage. Ample supplies appear to be available to meet current needs. The most encouraging feature of the situation is the improvement recorded in output last month as compared with the previous month. The demand, in this district at any rate, does not account for the amended output. Nevertheless, an increase of 40,000 tons is an appreciable one, bringing, as it does, the daily rate of production up to 17,536 tons. It is favourable also that, taking the kingdom as a whole, the number of furnaces in blast has increased by five to 136. Smelters would much like to see an increase in the consumptive demand of this district. They seem to be called upon to supply little except in small parcels of 10 tons or so of foundry material. For forge sorts there is hardly any demand at all. Derbyshire makers continue to quote No. 3 foundry at £3 to £3 1s. and forge £2 16s.; while Northamptonshire smelters' prices are £2 16s. to £2 17s. 6d. and £2 13s. 6d. for foundry and forge material respectively.

Manufactured Iron.

Activity in the Staffordshire iron trade is chiefly confined to best grade bars, of which there is a steady output. The price is maintained at £12 per ton. Competition for the business in Crown bar iron is very severe between the districts. Lancashire houses continue to underquote those of South Staffordshire, and the recent disparity in selling rates is in no way mended. The Black Country nut and bolt trade is consuming a good deal of cheap foreign material, which is still available at something under £7 5s. delivered. The iron trade in this district has not made the progress which, at the beginning of the year, was anticipated. This is in some measure due to the severe Belgian competition in the wrought iron trade. At the moment the situation is rather easier, as some users are coming to realise that there is a good deal of waste in continental parcels, and that it is advantageous to pay the higher prices for native material. These consumers are, however, unfortunately in the minority. The position has also been influenced by the fact that many makers of bolts and nuts have of recent date changed over to steel as their raw material. There is no change in the strip department, where wrought iron gas tube material sells only moderately at £10 15s. to £10 17s. 6d. per ton.

Iron Trade Hopes.

Lieutenant-Colonel J. S. Trinham, managing director of N. Hingley and Sons, Ltd., Netherton Ironworks, Dudley, says that the trade tendency at date is towards improvement. It is difficult to tell whether that tendency is due to a real improvement in trade or to decreased competition in steel from the Continent. The French and Belgian works are known to be fairly well booked with orders, and steel exports from Germany have been curtailed. It used to be that when steel got busy it had a similar effect upon the iron trade, but that is no longer so because of the competition in iron from Belgium. The slight improvement in the wrought iron trade at the moment is, he believes, because British users are beginning to realise that the material from abroad is, when being used up, very wasteful. When it comes to testing and re-testing, users are recognising that it is far better to pay for the better quality British material. This is the certain judgment of consumers to Messrs. Hingley's own knowledge. There is an impression in some quarters that it would be difficult to get large supplies of wrought iron in this country if there were the demand. Some users think rolled ironmasters could not live up to a good order book. But there are still two hundred puddling furnaces in this country in a position to work at any time the demand is made. Colonel Trinham estimates that, in the Midlands alone, if they could get a normal iron trade state, they could employ 4000 miners full time for twelve months.

Sheet Prices Advance.

Galvanised sheets, after an interval in which deficiencies in order books have been filled up at the basis of £13 7s. 6d., have advanced again to £13 10s. for corrugated sheets of 24-gauge. Some mills are not prepared to accept this figure, and ask a further half-crown for their output. There is very little unsold output over the rest of this year, and brisk inquiries are being received for January supplies. It is worthy of special note that last month shipments of galvanised sheets were up more than 40 per cent., the total of 71,031 tons being the best recorded for some time. Larger sales to India accounted for nearly half the increase of 21,000 tons.

Conditions in Chain Trade.

Prospects for employment in the chain trade during the forthcoming winter are not considered to be by any means bright. Whatever region is explored to predict the prospects there seems little ground for hope. Shipbuilding, mining and engineering are all industries which largely affect chainmaking, and if the condition of these trades is a criterion as to what is going to happen to the chain industry during the winter, the position, according to Mr. C. H. Sitch, general secretary of the Chainmakers and Strikers Association, will be no better than it was last year. He points out that at the present time there are something like 29·8 per cent. of the men engaged in the shipbuilding industry unemployed, 21·6 per cent. in the mining industry, and from 10 to 14 per cent. in the general engineering industry.

Proposed Abolition of Mines Drainage Commission.

It is proposed to abolish the South Staffordshire Mines Drainage Commission, and a Bill with that object is to be promoted in Parliament. A communication from the Ministry of Mines indicates that the Government is prepared to grant facilities in support of the Bill; and in view of the contents of the document and the present financial position of the Commission, it is not improbable that the latter will consent to extinction in certain terms. Negotiations have been in progress between the Commission, Coalowners' Association and individual colliery proprietors with the view to an agreement in reference to the costs incidental to the promotion of the measure.

Nut and Bolt Industry.

Though the nut and bolt industry in this area is favourably employed when compared with the other heavy trades of the district, such as iron and steel, edge tools and heavy engineering, the outlook is not so encouraging as it was twelve months ago. Somewhat irregular conditions exist in that section of the trade devoted to black engineering and wagon and colliery bolts. Considerable business has, however, been done recently by one or two firms in permanent way fastenings, screws, spikes, fish-bolts, &c. There is also, at date, a good demand for bright bolts and nuts for the engineering and motor industries. Nut and bolt manufacturers are to some extent feeling the effects of the importation of cheap continental bolts, but it is hoped the superior quality of the English-made article will stand it in good stead.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

More Hope for Heavy Industries?

MR. R. D. KITSON, chairman of Bolckow, Vaughan and Co., Ltd., in his address at the annual meeting here, took a somewhat more hopeful view of the outlook in the iron and steel trades than he did a year ago. While deploring the fact that production costs in this country continue high partly on account of the persistent policy of steel users in buying on a day-to-day basis, Mr. Kitson saw indications that conditions in this respect are changing. Owing to the fact that British costs have been reduced whilst those of continental competitors have been rising, and the general trend of wages on the Continent continues towards a higher level, more semi-manufactured steel is being made in this country. An interesting reference in the chairman's speech was to the directions in which steel may be substituted for other materials. There is ample scope, he said, to replace with steel the timber now used in the construction of railway freight and passenger coaches. Wooden sleepers are imported for railway track work, which in other countries are made of steel, while reports of mining inspectors indicate a growing use of steel supports for underground roadways and working places. Finally, Mr. Kitson referred to the negotiations now in progress for a fusion of the company's interests with those of other concerns.

"Skyscrapers" and Property Depreciation.

The question of property depreciation through the erection of high buildings of the "skyscraper" type was discussed by Mr. John Swarbrick in a paper before the Manchester Society of Architects. Even when modern high buildings are erected on isolated sites, a great deal of light might be excluded from buildings near them, and there has been considerable difficulty in properly assessing reasonable compensation. Mr. Swarbrick's contention was that it is possible by means of what were termed "sky projections" to determine accurately not only what light is excluded by a building that has been erected, but also the light which would be excluded by a building not yet in existence. It was considered to be highly desirable that by means of such projections building owners should ascertain the amount of compensation they are likely to be called upon to pay in respect of a contemplated building.

Ribble Power Scheme.

Preston Town Council on Monday decided to promote a Bill in the present session of Parliament authorising the construction of a weir across the river Ribble for the purpose of impounding water for the electricity works, the estimated cost of the scheme being £75,000.

Non-ferrous Metals.

All sections of the market for non-ferrous metals have experienced a "bullish" period since a week ago. In no instance is the tendency more marked than it has been in copper, the week's advance in standard brands bringing current values of these to a higher level than they were at the end of October, when the recent "peak" prices were established. A moderate trade has been passing in refined descriptions, which remain firm, although virtually unchanged on the week, whilst business in standard brands has been on a somewhat reduced scale. After the slight reaction reported a week ago, tin has experienced a rather important advance, in spite of the fact that warehouse stocks in this country show an increasing tendency. The demand from consumers has, however, been on a fair scale and the market has received a certain amount of support through speculative buying for forward delivery. The price improvement on the week is in the neighbour-

hood of £2 a ton. On balance, lead is about 5s. dearer, and fair quantities of the metal have changed hands. After an uncertain spell which has extended over several months, spelter is displaying a firmer tendency, values current at the moment of writing being back to where they were early in July, prices having responded to a bigger weight of speculative buying.

Iron.

Although new commitments on the pig iron market here continue on a relatively unimportant scale, so far as forward contracts are concerned, and spot orders are of no great weight, both Staffordshire and Derbyshire makers are, for the most part, receiving a fair volume of specifications for delivery, and although the experience is by no means general, certain producers are finding it not an easy matter on their present basis of operations at the blast-furnaces to maintain outputs on an adequate scale. On the other hand, however, there are others who are anything but satisfied with the rate at which delivery specifications are coming to hand. In spite of this, there is no indication of renewed weakness, and quotations are steady all round, with Staffordshire at 67s. 6d. per ton, Derbyshire at 68s., North-East Coast iron at 79s., Scottish makes at from 87s. 6d. to 90s., and hematite at about 82s., including in each case delivery in this district. With regard to manufactured iron, prices are fully maintained, with Lancashire Crown bars at £10 per ton and seconds at £9 10s. Makers, however, describe trade conditons in this section of the market as on no better than moderate lines.

Steel.

The buying of steel materials by Lancashire constructional engineers has fallen off appreciably during the past month or two, and recently has been comparatively slow. Up to the present there has been little actual improvement in the situation in this respect, though prospects, as a result of an increase in the number of inquiries for constructional work, are regarded as a shade brighter. An addition to the work in the hands of local firms has been furnished by the contract secured by Edward Wood and Co., Ltd., of the Ocean Ironworks, Manchester, for the erection of new engineering shops at Halesowen, Worcestershire, for Stewarts and Lloyds, Ltd. The demand for general plates is slow, though some business is being done in locomotive boiler plates, and a steady trade is passing in small bars. Current quotations for ship and tank plates are at £8 12s. 6d. per ton, with boiler plates at £9 10s. to £9 15s., joists at £7 17s. 6d., and 3in. and upward bars at £8 17s. 6d. Small bars have been advanced to £8 to £8 2s. 6d. per ton, according to quantity. There is only a relatively quiet demand about for imported steel materials, and except for semi-finished products the market in this section is fractionally easier than it has been, certain shippers regarding a prolongation of the stoppage in Germany as unlikely.

BARROW-IN-FURNESS.

Hematite.

The condition of the pig iron market in this district continues to be fairly steady, but there is just a suggestion of uncertainty about it. Prices have a tendency to stiffen a little, but that is not to be wondered at in view of the fact that stocks which had accumulated at the various works have now become low. The outputs from the eleven furnaces are at present being cleared, but it must be remembered that the steel works at Barrow and Workington are taking a fair tonnage, and should they stop—a happening which is not unlikely—there will be more iron produced than there are orders for, unless fresh customers are forthcoming. That seems to be unlikely unless America becomes a buyer. There is a certain amount of business in special qualities of iron for the Continent, and there have been several shipments lately. There is a slight chance of this trade developing. In the iron ore trade business remains about the same, and this condition is likely to continue. None of the mines are very active, and as regards foreign ore, this is arriving in restricted tonnage. The steel market is quiet, with orders few and hard to secure at even a small margin of profit. The works in this district are not well off for orders, and if the mills are to be kept running on railway material, fresh contracts are immediately required. The hoop mills are busy.

SHEFFIELD.

(From our own Correspondent.)

Signs of Improvement.

A BETTER feeling is apparent in several branches of the steel trade, chiefly those which supply material of the best quality for a variety of purposes. At the works of Vickers-Armstrong, which have been favourably placed for some time, a further increase of activity is reported, while at John Brown and Co.'s a 10-ton electric steel furnace, which has been idle for a considerable period, has just been placed in commission again. The United Strip and Bar Mills, at Rotherham, are busier than they have been ever since the plant was installed, and are able to dispose of the whole of their huge output, much of which is being sent abroad. Regular working is in progress at the Templeborough wire rod mill, which has a very large capacity. There are full order books at the heavy foundries of two of the large Derbyshire ironworks, the activity relating chiefly to pipes for home and export, and calling for the consumption of a large tonnage of pig iron.

In Other Directions.

No considerable booking of new orders for semi-finished material can be reported, but a good output is being maintained in consequence of business previously placed. The position of the railway steel departments shows no improvement. The home companies are still specifying very small quantities of work, and there is much slackness at the rail, tire, and axle plants. In various ordinary lines of the steel trade, work is scarce, and as a result of keen competition prices are severely cut. In hand tools, the business relates principally to oddments, orders for substantial quantities being very occasional. The departments dealing with saws, files, farm and plantation tools all complain of slackness, though the position is not quite as bad as it was not long ago. The prospect of an increase in the tariff on files in Spain has led to increased shipments to that country A valuable order for files for Russia has just been completed, but there is no probability of further business being done with that country during the winter. There is much cutting of tool prices.

Cutlery and Plate.

While the demand for medium-class goods in the cutlery and plate trades does not seem to have benefited much from the approach of Christmas, there has been a seasonal spurt in other directions. In only a minority of cases, however, is a satisfactory business being done. Several of the leading firms report a good demand for high-quality goods, and are likely to continue busy until well on in December, even if no further orders are placed. There are some good orders on hand for ship and hotel equipment. There is also activity in the cheapest side of the trade, in which makers have many orders on hand and are fully employed. Much activity is reported in the case of two or three firms possessing plant for mass production. Firms which supply cases or cabinets to hold cutlery and plate have had a seasonal trade well up to the average, if not exceeding it ; and for small cardboard boxes there has been an enormous call. Apart from the bazaar trade, the demand for spoons and forks is much below that of a year ago. A London house is competing severely, at cut prices, for a good deal of the business which was formerly done in Sheffield and Birmingham.

Research on Cold-worked Steel.

A branch of local industry which has grown rapidly of late years is that which produces cold-worked material, in the form of wire, strip, sheet and other products. The progress of this side of trade will be greatly assisted by a benefaction which the Ironmongers' Company of London have just made to the University of Sheffield. The Company has decided to found a Research Fellowship and two Research Scholarships, for which purpose it will make a grant of £800 a year for seven years to the University. Certain applications of cold-worked material, such as those of the aircraft industry, call for the very highest qualities. Hitherto, the research work necessary to obtain such qualities has been carried out mostly by the manufacturing firms, although certain investigations of importance have been made in the universities of this country. A point has now been reached at which the producers of the material find that problems arise which cannot be solved without provision for systematic research by trained investigators. It is intended, therefore, to establish and equip a laboratory in the Applied Science Department of Sheffield University, with the necessary plant for drawing and rolling steels, and with all the apparatus which will be required for a systematic study of the metallurgical changes which are involved in the processes, and of the engineering conditions which will give the most favourable results. It is hoped that the necessary plant for carrying out the work will be provided by the generosity of the manufacturers, through the Cutlers' Company of Hallamshire. Mr. Percy Lee, the ex-Master Cutler, has interested himself for some months past in the problem of cold working, and is largely responsible, together with Mr. E. A. Ebblewhite, Master of the Ironmongers' Company, for the scheme submitted to the Company by the University, which has resulted in the substantial grant being made.

A Busy Shipyard.

It is a matter of much interest to Sheffield to know that one of its great shipbuilding firms—that of Cammell Laird and Co., Ltd.—is very well placed for work. The managing director of the firm's Birkenhead yard stated last week that it had enough work to carry operations over the whole of the winter, giving employment to practically all its regular employees. It was now paying in wages £20,000 a week, and employing 8000 men, the largest number at any time in the last ten years. The firm a few days ago launched the steamer "Lady Somers," built for the Canadian National Steamships' Canada–West Indies service. She is the fourth of a fleet of five vessels which the firm is building for that service, and is of 7750 tons gross register, with a speed of 14 knots. She has specially designed refrigerator space for 100,000 bunches of bananas. She will carry only first-class passengers.

Sewage Works Extensions.

A Ministry of Health inquiry was held in Sheffield last week with regard to an application by the Corporation for sanction to borrow £134,000 for the extension of the sewage disposal works at Blackburn Meadows. The scheme is one regarding which Government grants have been obtained for the finding of work for the unemployed, and the Corporation is anxious to get the extension approved, so that it can continue to provide employment for men who would otherwise be on the registers of the employment exchange. It was stated that the extension would enable work to be found for 100 additional men, and that the men working on the existing scheme would be retained. It is also proposed to remodel and enlarge existing sewage works at Hollinsend, at a cost approaching £19,000.

Lighting an Aerodrome.

The Electricity Committee of Hull Corporation has accepted an application from the Blackburn Aeroplane Company, Ltd., for a supply of electricity to its works and aerodrome at Brough, under a seven years' agreement.

A Works Extension.

How to extend one's works without either acquiring more land or interfering with "output" is a problem which many firms have to face. James Neill and Co. (Sheffield), Ltd., of Composite Steel Works, Sheffield, has recently successfully overcome both these difficulties by constructing an additional machine shop on a level with the first floor of their hack saw department, in Napier-street, to enable them to deal with the increasing demand they are receiving for their "Eclipse" hack saw blades and frames without interfering with the output. The new shop was built over a portion of the ground-floor premises occupied by the firm's crucible furnaces. It is constructed entirely with fireproof materials, the floor being of reinforced concrete and the roof supported by steel principals specially designed to receive shafting. The lighting has been very carefully considered, one side of the roof consisting of glazing with wire wove glass along its entire length, the other side being lined with beaver boarding, which acts as an efficient reflector in throwing the light downwards on to the machines. A feature of the new shop is the labour-saving lay-out adopted. It was considered impracticable to adopt a conveying system, because of the great variation in the sizes of the hack saw blades, and instead a system of special racks and trays made to standard measurements was adopted, in order that the blades could be accommodated, without trouble or waste of space, close to each machine. For each operation the blades are so arranged as to give the operator complete control of the work being done, and great care has been taken to make the operator as comfortable as possible, in order to minimise fatigue and monotony, which are the characteristics of repetition work.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Outlook.

TRADE seems to be taking a turn for the better in all directions in the North of England. The coal trade is much more active, the iron and steel trades are showing a pleasing indication of gradual revival, and the shipbuilding industry appears to be on the verge of one of the biggest revivals that it has experienced in post-war days. Several orders for new vessels have been placed this week, and there are numerous inquiries for new tonnage circulating. Continuation of the deadlock in the iron and steel trade in Germany is now beginning to have some effect on trade in this area. The feeling still prevails that the lock-out will not be lengthy, but it is strengthening the hands of manufacturers in this area. Apart, however, from whatever effect the situation in Germany may have on the Northern iron and steel market, long hoped for indication of movement in the direction of trade revival is not absent. With prospect of lessened cost of production in this district, while labour unrest abroad and other factors tend to contribute to increase working expenses on the Continent, conditions appear to be gradually turning in favour of British producers. Firms in this district report not only improvement in inquiries, but some actual expansion of business.

Cleveland Iron Trade.

A marked improvement is noticeable in the Cleveland pig iron trade. Stocks are low, and makers stated that their marketable iron is selling readily, though consumers in quarters hitherto largely supplied from Cleveland are still making rather extensive use of the comparatively cheaper products of other home districts. Pig iron production is far from heavy, and that output is insufficient for current needs is emphasised by the action of Dorman, Long and Co., Ltd., in rekindling an idle blast-furnace this week at their Acklam Ironworks. This increases the number of blast-furnaces in operation on the North-East Coast to 31, as compared with between 60 and 70 blowing in normal pre-war times. Prior to 1914, however, the output capacity of a furnace was much below the present up-to-date plant. Prices of Cleveland pig iron are firm, No. 1 foundry being 68s. 6d. ; No. 3 G.M.B., 66s. ; No. 4 foundry, 65s. ; and No. 4 forge, 64s. 6d.

Hematite Pig Iron.

Manufacturers of East Coast hematite pig iron are now in a very strong statistical position. Their stocks have dwindled to vanishing point, and their restricted output promises to be inadequate to the steady moderate demands of home and continental consumers. Buyers are coming forward quite freely and are anxious to arrange forward contracts at round about current rates, but makers are not disposed to commit themselves at all extensively. Producers have no arrangement as to the fixing of prices, and quotations being a matter of individual bargaining vary somewhat, but the equivalent of 71s. for ordinary qualities is now rather readily paid.

Ironmaking Materials.

The situation as regards foreign ore is unaltered. Business is quiet, but sellers adhere firmly to quotations on the basis of best Rubio at 22s. 6d. c.i.f. Tees. Demand for blast-furnace coke is little improved. Good average qualities keep at 17s. 6d. delivered to works in this area.

Manufactured Iron and Steel.

In several branches of the manufactured iron and steel trade orders are coming forward more freely, and with inquiries on a much improved scale prospects are regarded as distinctly brighter. Finished steel for constructional engineering purposes is in fairly good request, and specifications for shipbuilding material are increasing. Railmakers have a considerable amount of work on hand, and sheet producers are heavily sold to the end of the year. Semi-finished steel is in quite brisk demand, and values are showing an upward tendency.

The Coal Trade.

The Northern coal trade outlook continues to improve. Most of the collieries in both Northumberland and Durham are now busier than they have been for two or three years past, and there is every indication that the

more active conditions will be maintained. The difficulty at the moment is that of securing a good tonnage supply, and delay is occasioned at the coaling staithes. The problem, however, is being discussed between colliery representatives and railway officials, and it is hoped that some relief will be afforded in the course of a few days. Every effort will have to be made to ensure that no check is put to export trade just when it shows signs of being on the up grade. The recent firmness in the steam coal market is fully maintained, and under a brisk inquiry, prompt and forward, fitters are holding to full late quoted prices and several grades are tending higher. Suitable tonnage is decidedly scarce, and for any boats available merchants have to pay high prices, which tends to induce shippers to postpone orders. The prompt position, however, is favourable, and best Northumberland steams are very firmly quoted at 14s. 3d. for prompt and 14s. to 14s. 3d. forward. Durham steams are in a favourable position as regards orders booked, but find the tonnage difficulty very serious and in many instances the pits are reduced to short time working. Steam smalls are still a disappointment, and detract from the benefit accruing from the sale of large coal. Gas coals are not attracting as much business as is usual at this period of the year, but the tone is steady for best brands. Seconds remain rather quiet. There is a shade more inquiry for coking coals, but it is difficult to get more than 13s. 3d. for ordinary descriptions. The position in the coke trade is irregular. Gas coke, whilst well sold by makers, is freely offering through contractors at 19s. 3d. to 19s. 6d. to secure a quick clearance. Makers ask firmly 20s. for delivery over the next two months. Patent cokes are meeting a slowly expanding demand, but stocks are plentiful, and offered at recent values. Good ordinary brands are 18s. 3d. to 18s. 5d. beehive and special grade cokes 23s. 6d. to 28s. 6d.

Shipbuilding Orders.

Sir William Reardon, the Cardiff shipowner, is negotiating with North-East Coast shipbuilders for the construction of seven vessels each of 8000 tons, and it is understood that arrangements are nearing completion. An order for two more cargo boats, of about 9100 tons deadweight, has been placed by Sir R. Ropner and Co., Ltd., with William Gray and Co., Ltd., of West Hartlepool, who already have on their stocks two similar vessels recently ordered by the same owners. In a period of just over two years Ropner and Co. have given out orders for about two dozen vessels, and in the past twenty months have taken delivery of no fewer than ten of them from Messrs. Gray. Short Brothers, Ltd., of Sunderland, have received an order for three new cargo ships of over 10,000 tons deadweight each. The owners' names have not been divulged.

SCOTLAND.

(From our own Correspondent.)

Steel and Iron.

While there is not much improvement in actual turnover, better inquiries have been in circulation, and a slightly more optimistic feeling is apparent in the steel and iron markets. Markets have not, so far as can be ascertained, been affected to any extent by the stoppage in Germany, though a continuance of the stoppage there would eventually favourably affect home producers; but recent shipbuilding orders will undoubtedly mean a considerable amount of work for local steel and ironworks, which will be welcomed by producers of heavy steel in particular. Steel plates and sections have been in somewhat better demand, but the capacity of the works is far from being taxed. Steel sheet makers are well placed so far as the lighter gauges are concerned, and also galvanised descriptions, but heavy sheets are slow. The production of bar iron is very subdued, both home and export demands being restricted. The re-rolled steel departments, on the other hand, are active, the demand for bars and tube hoops having improved considerably. Re-rolled steel bars have firmed to £7 15s. per ton, home or export. Re-rollers, however, have only limited stocks of raw materials on hand, and if the continental situation does not improve soon, home sources of supply will have to be utilised, involving a probable further increase in prices.

Pig Iron.

Demands for pig iron are not expanding, and business in hematite and foundry qualities is of small account. Prices are unchanged.

Exports and Imports.

During the past week 12,000 tons of iron ore, 2600 tons of steel and iron materials, and 250 tons of pig iron were unloaded at Glasgow harbour. Exports included 2600 tons of steel and iron products and 768 tons of pig iron.

Coal.

The outlook in the Scottish coal market still lacks encouragement. Both prompt and forward shipping demands are on restricted lines, despite fair inquiries, buyers being evidently unprepared to pay current prices. Business therefore is practically confined to the covering of former sales, and small orders for early dispatch. Restricted outputs maintain prices on a firm level, however. Certain descriptions are comparatively well placed, and these include Lanarkshire ells and splints, Fifeshire first and third-class steams, especially the latter, and Lothians steams. Treble nuts in all districts are strong, but smaller sizes show a weaker tendency. Aggregate shipments amounted to 230,524 tons, against 249,713 tons in the preceding week and 259,997 tons in the same week last year. Home demands are irregular and merchants have not yet been able to secure the higher prices quoted since the beginning of November.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

From the loading point of view, the conditions this week are better in the coal trade than they have been for several weeks past. The docks are much busier, and some collieries have really more tonnage at their disposal than they can conveniently deal with. Others, of course, are not so well placed. The whole position has been upset as the result of the severe gale which prevailed on Friday last, when work was compelled to cease. In some instances steamers in dock sustained damage by breaking from their moorings. Other vessels at sea have had terrible passages, and it is not surprising that colliery arrangements for loading have since been considerably disorganised. There were over thirty idle tipping appliances at the various docks on Saturday last, but on Monday, as the result of arrivals, this figure was reduced to fifteen, and since then additional tonnage has come along, the consequence being that there is substantial pressure for most of the leading qualities. The only unfortunate part of this busy period is that it may be followed by a lean period, as although there are a very fair number of orders on the market, chartering of late has rather fallen off. It would not be surprising, however, if December showed a recovery. Most exporters will bear in mind the fact that they can only calculate upon roughly three weeks in which to effect shipments on account of the Christmas holidays, and they will therefore show a disposition to work off their commitments more promptly than is usually the case. The demand from abroad does not display any material expansion, though it is well maintained.

October's Record.

It would be almost too much to expect that the returns of coal exports from this district for the current month will come up to the level of those for October. That month turned out to be satisfactory, all things considered, as the total came, according to the Board of Trade returns, to 1,858,216 tons. This quantity works out as the highest monthly total for this year, with the exception of the months of March and June. Furthermore, the average f.o.b. price of all coals for October was about 17s. 10d. per ton, which was 5d. per ton above the figure for September, and was, in fact, the highest average price for any month of this year. It is possible that this price may be maintained for November, but there is a doubt whether exports will be quite as good owing to the scarcity of tonnage during the first fortnight. Last week's total at 388,800 tons was better than for the preceding week, when the quantity was just over 351,000 tons, but still was disappointing.

Pit Stoppage.

Mention was made of the fact last week that work had ceased at the pits of Nixon's Navigation Company, Ltd., at Mountain Ash, with the result that about 5000 men are added to the list of unemployed. Since then fifty-five officials of the company have been discharged, and only those officials who are required for the working of the fans, the airways and pumps, &c., are retained. It does not look, therefore, as if there will be work at the pits for some time. As a matter of fact, a receiver and manager has been appointed. Negotiations for the sale of the property have unfortunately not matured.

Tin-plates for Spain.

At a recent meeting of Welsh manufacturers of tin-plates it is reported that considerable discussion was given to the question of the demand of Spanish tin-plate makers upon their Government to advance the import duty on Welsh supplies sent to Spain. Coal exporters have for some time past been harassed with the barriers which Spain has set up against imports of coal from this country, but it looks as if Welsh makers of tin-plate are likely to suffer even more severely if the Spanish tin-plate manufacturers get their way. It is reported that their demand is for the doubling of the import tariff, which, if carried out, would mean the complete stoppage of exports of tin-plate from this country.

New Ships.

Although no official statement is so far forthcoming, it is understood that negotiations have been practically completed for the construction of seven steamers by Messrs. Gray and Co., of West Hartlepool, for Sir Wm. Reardon Smith, the well-known Cardiff shipowner, but from all accounts there is one point at issue. It is reported that this is a stipulation on the part of Sir W. R. Smith that ship-plates of Welsh steel shall be utilised in the construction of the ships, which, of course, would mean work for this district.

Current Business.

There is no change in the market for steam coals so far as prices are concerned. But the conditions are slightly steadier on account of delayed tonnage arriving up together with the result that the better grades of coal are for the time being very tightly stemmed. On the whole, the market displays a certain amount of irregularity, as some collieries are still in want of prompt orders. Sized coals generally are quietly firm. The demand for coke is well maintained, but patent fuel shows no improvement. Pitwood has a slightly easier tendency, as buyers now expect that supplies will come along more freely, inasmuch as the strike troubles at Bordeaux, which have prevailed for several weeks past have come to an end.

H.M.S. Resource.—In his letter last week our Barrow-in-Furness correspondent fell into an error in stating that the naval tender H.M.S. "Resource," shortly to be launched from Vickers-Armstrongs' yard, will be propelled by internal combustion engines. Although at an earlier point in design it was stated that the vessel would be so propelled, the Admiralty decided later to install steam turbine machinery, and it is being constructed by Vickers-Armstrongs.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Mr. Horace J. Young, of 3, Central Buildings, Westminster, London, S.W. 1, asks us to announce that he has resigned his Fellowship, of the Institute of Chemistry.

Mr. P. B. Silk, who was until recently with the English Electric Company, Ltd., asks us to announce that he has now organised, and is managing director of, the Ash Company (London), Ltd., of 7, Sussex Mansions, Maiden-lane, W.C. 2.

George Ellison, of Perry Barr, Birmingham, asks us to announce that his Newcastle and District branch office has been transferred from Milburn House to "Carliol House," Newcastle-on-Tyne; the telephone number, Central 1325, and the telegraphic address, "Starters," are not altered.

CONTRACTS.

The B.E.N. Patents, Ltd., of 92, Tottenham Court-road, London, W. 1, has received an order to supply B.E.N.-Myers car washers to the Maharajah of Patiala.

International Combustion, Ltd., of Africa House, Kingsway, London, W.C. 2, informs us that its French company, La Société Anonyme des Foyers Automatiques, of Paris, has received orders for Lopulco pulverised fuel equipment from (1) La Société Houillère de Sarre and Moselle, of Merlebach, France; and (2) La Compagnie Auxiliaire d'Electricité, of Brussels.

The Harland Engineering Company, Ltd., in association with the British Electric Plant Company., Ltd., of Alloa, Scotland, has received from the Canadian Government the order to supply all the electric motors required to operate the sluice valves and taintor valves of the lock gates on the Welland Ship Canal, Ontario. The taintor valves, which will be operated by Harland motors, will weigh over 14 tons each, and will measure 7ft. by 14ft. There are eight to each lock.

Yarrow and Co., Ltd., inform us that their licensees in Holland, Messrs. "De Scheide," of Flushing, have recently secured the following orders for Yarrow boilers in Holland:—(*a*) Nijmegen Power Station—two, each of 100,000 lb. per hr.; (*b*) Philips Lamp Factories, Eindhoven—three, each of 35,000 lb. per hr.; (*c*) Geertruidenberg Power Station (repeat order)—four, each of 150,000 lb. per hr.; (*d*) Rotterdam (repeat order)—one, of 120,000 lb. per hr.; and (*e*) Van Gelder Zonens Paper Works, Velsen—two, each of 70,000 lb. per hr.

The Great Western Railway Company officially announces that the following contracts have been placed:—(*a*) Supply and erection of a 25 cwt. electric portable single motor jib crane for Millbay Pier, Plymouth: Holt and Willetts, Cradley Heath; (*b*) supply and erection of a 1½-ton overhead travelling electric crane at Bristol—Temple Meads—Goods Station: Holt and Willetts, Cradley Heath; (*c*) supply and erection of a pair of dock gates and other works for lower end of the lock at Penarth Dock: Vickers-Armstrongs, Ltd., Broadway, Westminster, S.W. 1; (*d*) supply of steel girders and other steel and ironworks: Fairfield Shipbuilding and Engineering Company, Ltd., Chepstow; (*e*) erection of ten lock-up garages, Sydney Wharf, Bath: Hemery and Mallett, 29, Wells-road, Bath; (*f*) supply and delivery of a steel mooring buoy, Newport Docks: The Cradley Boiler Company, Ltd., Cradley Heath; (*g*) supply of a steel framed corrugated iron building, Barry Docks: Walker Bros., Ltd., Walsall; (*h*) installation of electric lighting in offices and stores, Stafford-road, Wolverhampton: Walter Parkins and Co., Goldthorn Hill, Dudley-road, Wolverhampton; (*i*) repairs for overhaul of great hopper barge "Mudeford": Thos. Diamond and Co., Ltd., Cardiff; (*j*) repairs and overhaul of steam hopper barge "Sir Henry M. Jackson": The Ocean Dry Docks Company, Ltd., Swansea; (*k*) carrying out repairs to roof of Mint Stables, Paddington, W. 2: Edward Proctor and Sons, 326, High-street, Plumstead; and (*l*) supply and delivery of moorings, screws, rings and cables, &c., for dock moorings at Newport Docks: Brown, Lenox and Co., Ltd., Pontypridd.

LAUNCHES AND TRIAL TRIPS.

Tilsington Court, single-screw cargo steamer; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of United British Steamship Company, Ltd.; dimensions, 420ft. by 56ft. 2in.; 11,000 tons deadweight. Engines, triple-expansion, pressure 180 lb. per square inch; a successful trial trip was run on November 6th.

Oilpioneer, single-screw motor tanker; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of British Oil Shipping Company, Ltd., London; dimensions, 424ft. by 53ft. 3in.; 8650 tons of petroleum. Engines, set of seven-cylinder "Neptune" Polar-Diesel engines; constructed by the builders; a speed of about 12¼ knots was attained on trial trip recently.

Creole Bueno, twin-screw oil tanker; built by Palmers' Ship building and Iron Company, Ltd., to the order of Sir Joseph W Isherwood and Co., Ltd.; to carry petroleum in bulk; trial trip November 14th.

Celtic Monarch, steel screw cargo steamer; built by D. and W. Henderson and Co., Ltd., to the order of Raeburn and Verel, Ltd.; dimensions, 430ft. by 56ft. by 30½ft.; 5800 tons gross. Engines, quadruple-expansion, 25in., 35½in. 51in., and 72in. by 51in. stroke, pressure 220 lb. per square inch; constructed by the builders; launch, November 15th.

Tug, twin-screw salvage tug; built by Philip and Son, Ltd., Dartmouth, to the order of Crown Agents for the Colonies (Ceylon Harbour Service); dimensions, 150ft. by 37ft. by 18ft. Engines, triple-expansion, constructed by the builders; launch, November 17th.

The Institute of Fuel.—The annual dinner of the Institute of Fuel was held at the Connaught Rooms on Wednesday last, with Lord Melchett, the President, in the chair. It was a very pleasant function, and there were a number of ladies present, so, when the more formal business of the evening had been completed, the room was cleared and dancing passed away the rest of the time to midnight. In proposing the toast of "The Institute of Fuel," Mr. Bridgeman said that the Admiralty were very sympathetic with the aims of the Institute, and was willing to do anything in its power to further its researches. In his response, Lord Melchett pointed out what a loss to the Welsh coal trade had been effected by the change in our Navy from coal to oil fuel, but suggested that by the hydrogenation of coal it would be possible for naval oil fuel to be produced within the country. Sir David Milne Watson proposed the toast of "The Visitors," and after commenting on the multitude of conferences which now take place, paid a tribute to the help which Japan has given towards the solution of fuel problems. Mr. Sadao Saburi, who responded, gave a cordial invitation to all interested to the next World Fuel Conference, which is to be held in Tokyo in the spring, and was supported by Lieut.-Colonel K. Edgcumbe, the President of the Institution of Electrical Engineers. Mr. J. H. Thomas proposed the health of the President, and in a most amusing speech urged the really economic use of our coal rather than the importation of foreign fuels.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	16/6 to 21/6
(1) Spanish	16/6 to 22/6
(1) N. African	16/6 to 22/6
N.E Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 11 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 12 0	3 12 0
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 16 0 to 2 17 6	—
Forge	2 13 6	—
(3) Derbyshire—		
No. 3 Foundry	3 0 0 to 3 1 0	—
Forge	2 16 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 0 0	—
No. 4 Forge	2 17 6	—
Basic	3 0 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 0 0 (a); 4 2 6 (b); 4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Double Best Bars	11 5 0	—
Treble Best Bars	11 15 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 2 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 12 6 to 8 17 6	—
Gas Tube Strip	10 15 0 to 10 17 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal.Cor. 24 B.G)	13 10 0 .. 13 12 6	to 13 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W Coast—		
Barrow—		
Heavy Rails	8 0 0	—
Light Rails	8 5 0 to 8 10 0	—
Billets	6 15 0 to 9 15 0	—
Manchester—		
Bars (Round)	8 17 6	—
,, (Small Round)	8 0 0 to 8 2 6	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6 to 8 17 6	—
,, (Lancs. Boiler)	9 10 0 to 9 15 0	—
Sheffield—		
Siemens Acid Billets	9 0 0	—
Hard Basic	7 2 6 and 7 12 6	—
Intermediate Basic	7 0 0	—
Soft Basic	6 10 0	—
Hoops	9 0 0	—
Soft Wire Rods	7 10 0	—
Midlands		
Small Rolled Bars	7 15 0 to 8 0 0	—
Billets and Sheet Bars	6 7 6 to 6 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 10 0 to 13 12 6	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/- to 18/1½
Block Tin (cash)	231 17 6
,, (three months)	227 15 0
Copper (cash)	68 3 9
,, (three months)	68 12 6
Spanish Lead (cash)	21 2 6
,, (three months)	21 7 6
Spelter (cash)	25 2 6
,, (three months)	25 0 0
Manchester—	
Copper, Best Selected Ingots	73 17 6
,, Electrolytic	75 10 0
,, Strong Sheets	98 0 0
,, Tubes (Basis Price), lb.	0 1 1½
Brass Tubes (Basis Price), lb.	0 1 0½
,, Condenser, lb.	0 1 2½
Lead, English	22 15 0
,, Foreign	21 12 6
Spelter	25 5 0
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 10 0	7/6
,, ,, 6 p.c. to 8 p.c.	£20 10 0	7/-
,, ,, 8 p.c. to 10 p.c.	£20 0 0	6/-
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	12/-
,, ,, ,, 1 p.c. carbon	£37 0 0	15/-
,, ,, ,, 0·70 p.c. carbon	£41 0 0	17/-
,, ,, ,, carbon free	1/- per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£19 0 0 scale 6/- per unit	
,, Vanadium	14/- per lb.	
,, Molybdenum	4/3 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/- per lb.	

FUELS.

SCOTLAND.
(Prices not stable.)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	16/-
,, ,, Splint	16/- to 16/9
,, ,, Trebles	14/9 to 15/6
,, ,, Doubles	13/9 to 14/-
,, ,, Singles	12/6 to 12/9
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	15/6
,, ,, Trebles	15/6 to 16/-
Fifeshire—	
f.o.b. Methil or Burntisland—Steam	12/9 to 13/-
Screened Navigation	13/-
Trebles	15/6 to 16/6
Doubles	13/3
Singles	12/9
Lothians—	
(f.o.b. Leith)—Best Steam	13/- to 13/6
Secondary Steam	12/6 to 12/9
Trebles	15/6 to 16/6
Doubles	13/- to 13/3
Singles	12/9

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		25/6
Household		38/6 to 51/-
Coke		22/6 to 23/6
Northumberland—		
Best Steams		14/- to 14/3
Second Steams		13/- to 13/6
Steam Smalls		9/-
Unscreened		11/9 to 12/-
Household		21/- to 27/-
Durham—		
Best Gas		14/9
Second		13/- to 13/3
Household		21/- to 27/-
Foundry Coke		18/6 to 19/6
Sheffield—		
Best Hand-picked Branch	26/- to 27/6	—
Derbyshire Best Bright House	23/- to 24/6	—
Best House Coal	20/6 to 21/6	—
Screened House Coal	17/- to 18/-	—
,, ,, Nuts	16/- to 18/-	—
Yorkshire Hards	14/6 to 16/-	—
Derbyshire Hards	14/6 to 16/-	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	4/6 to 6/-	—
Smalls	3/6 to 4/-	—
Blast-furnace Coke (Inland)	13/6 at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		19/- to 19/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/- to 19/3
Best Dry Large	17/9 to 18/6
Ordinary Dry Large	17/ to 17/3
Best Black Vein Large	17/6 to 17/9
Western Valley Large	17/- to 17/3
Best Eastern Valley Large	16/6 to 17/-
Ordinary Eastern Valley Large	16/3 to 16/6
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	10/6 to 12/-
Washed Nuts	18/- to 20/-
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	14/- to 14/6
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	11/- to 12/-
Foundry Coke (export)	27/- to 37/-
Furnace Coke (export)	19/- to 21/-
Patent Fuel	20/- to 21/6
Pitwood (ex ship)	29/- to 29/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	34/- to 35/6
Seconds	24/6 to 28/6
Red Vein	22/- to 27/-
Machine-made Cobbles	40/- to 43/6
Nuts	36/- to 43/6
Beans	23/6 to 25/-
Peas	17/3 to 18/-
Breaker Duff	8/- to 8/6
Rubbly Culm	10/6 to 10/9
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	12/- to 12/6
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

Commercial Vehicles.

During the past decade manufacturers of commercial vehicles found it difficult to make headway against the many thousands of American lorries which were thrown on the market after the Armistice, and of which there is still a considerable number in service. The effect of this off-loading of American war stocks may have been disastrous to home manufacturers for the time being, but the acquisition of such vehicles at low prices by users, who would otherwise not have purchased motor lorries, brought home to public works' contractors and others dealing with heavy material the value of motor road traction. During the past year or two the use of commercial vehicles has become so general as to affect seriously the situation of the railways. There is found to be a considerable saving in time and money in carrying goods by road over such long distances as between Paris and Strasburg and between Paris and Lyons. The annual show of commercial vehicles which has been held in the Grand Palais, Paris, therefore attracted far more interest than ever before. That interest was observable more particularly in the manner in which French manufacturers are dealing with the problem of cheap transport. The French have long been endeavouring to shake off their dependence on a fuel which places them at the mercy of foreign oil producers, and they are convinced that the future development of road traction depends upon greater economy in fuel consumption. Especially is it hoped that suction gas may become eventually a standard fuel for heavy commercial vehicles, and although the progress made is far less rapid than had been anticipated, principally on account of the high maintenance charges through the generally inadequate scrubbing of the gas, one of the oldest motor car firms is nevertheless turning out each month 200 charcoal suction gas lorries, specially intended for the Colonies. It is declared that the difficulties in the way of supplying the engine with a clean gas have been overcome, and that by adapting the engine to the use of suction gas the efficiency obtained is highly satisfactory. Obviously, from the point of view of economy, when taking into account more particularly dead load maintenance charges and loss of time in starting, the suction gas lorry can only have a limited application if French makers should succeed in following the example of the Germans by developing the type of high-speed engine running on the Diesel principle. So far, Peugeot and Ballot are the only firms which have made any attempt to develop engines of this type, the former being based upon the Junkers principle, which is also embodied in the engines of the Société Lilloise des Moteurs. The high-speed heavy oil engine is attracting a great deal of attention, but its application to motor vehicles is still in a tentative stage, until such time as something more definite is known about maintenance charges, which, it is often alleged, are high. Another source of energy which has so far made little headway is electricity, despite the efforts made by electrical companies to encourage it for traction in towns. It is, however, meeting with some success in Lyons and other centres where there are special facilities for obtaining cheap current. At the Paris Show there was an electric chassis for a 5-ton load. The weight of the batteries was about 2 tons. It is claimed for electric lorries and public service vehicles that owners know exactly what they will cost them. The ordinary batteries are guaranteed for three years, and the cost of recharging them during the night is particularly low. On the other hand, the distance covered on a single charge is only about 30 miles, but that is usually sufficient for delivery services in town.

Lorry Developments.

The chief development of the lorry chassis, as observable at the Paris commercial vehicle show, is an attempt to increase the paying load by extending the frame and using six wheels, or by employing a tractor similar to the Nash Quad and coupling it to trailing vehicles. In the latter case, the system is useful for firms which are constantly loading and unloading vehicles, the tractor being, therefore, always at work. The six-wheeled vehicle is lending itself to some interesting developments. Berliet has succeeded in taking the drive from the engine to the rear differential shaft and then to the central and fore axles by worm gearing. The frame is efficiently suspended on a heavy-section tube carrying the central axle, and half springs extend to the rear differential and to the tube carrying the front axle. Steering is effected by both fore and aft wheels. The vehicle is designed for running on any kind of rough ground, and the one exhibited was equipped with anti-aircraft guns. Something entirely different was the six-wheeled chassis shown by Miesse, of Brussels. The drive is direct to twin differential shafts, the tubes of which constitute a strong and well sprung support for a particularly long frame.

Railway Progress.

Monsieur Javary, the director of the Chemins de Fer du Nord, has been giving some impressions upon what has been accomplished by the company in the way of improving the service. Since the reconstruction was undertaken ten years ago, the company has been increasing the weight of the rolling stock and increasing the speed until the limit has now been reached, and there can be no hope of doing anything better except by entirely new methods of compounding locomotives which are now receiving attention. In the way of rolling stock, the new all-steel coaches have been given what is practically a tubular form with the ends strongly reinforced. There are forty of them, and they cost about half a million francs each, so that they will probably be confined to the *rapide* trains. The weight of the all-steel coach, in which there is not a single rivet, is 46 tons, or 12 tons more than the ordinary coach. On account of the increasing weight of the rolling stock the permanent way has been improved with heavier ballast. The length of rails has been increased from 18 m. to 24 m., and the number of sleepers from eighteen to thirty per pair of rails.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

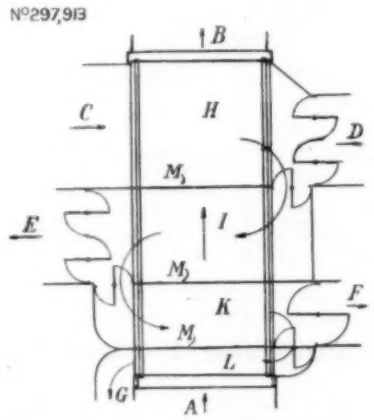
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

LIGHTING AND HEATING.

297,913. July 26th, 1927.—Improvements in and connected with Air Heaters, Babcock and Wilcox, Ltd., of Babcock House, Farringdon-street, London, E.C. 4, and George Turkus, of the same address.

This invention relates to improvements in air heaters of the type in which the hot gases travel through tubes or ducts, while the air passes over the outer surfaces of such tubes or ducts in a zig-zag path, determined by transverse baffles. The invention has for its object to provide an improved arrangement of air heater by which air at two or more different temperatures is commercially obtained. A is the gas inlet and B the gas outlet of the heater. C indicates the air inlet. At points spaced in relation to the flow of air there are provided in the body of the air heater damper-controlled openings D, E, F and G through which fractions of the air being heated may be drawn off. The entire volume of air enters the heater at C and flows over the heating surface to the point D, where it has

N°297,913



become heated to the lowest of the several required temperatures. At this point the quantity of air required at that temperature is taken away through the opening D, controlled by dampers, whilst the remainder of the air flows over the heating surface to the point E, where it has become heated to the next higher of the several required temperatures, when the quantity of air required at that temperature is taken away through the second opening E, controlled by dampers, the remaining air flowing over the further heating surface and to the points F and G, where fractions at higher temperatures are drawn off. In order to obtain advantageous rates of heat transmission throughout the air heater, notwithstanding that the quantities of air passing over various parts of the heater are unequal, the cross-sectional areas of the air passages H, I, K, and L, in successive parts of the heater, are made unequal by disposing the transverse air baffles M at unequal distances apart, these distances being largest between C and D and smallest between F and G.—*October 4th*, 1928.

STEAM GENERATORS.

282,809. December 29th, 1927.—Improvements in or relating to Electric Motor Control Mechanism for Furnaces, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, W.C.* 2.

The induced draught fan A is driven by an alternating-current variable-speed motor B, which also drives an alternating-current generator C, which is separately excited by current from direct-current bus-bars D. The forced draught fan E is driven by an alternating-current motor F, and the fuel-supplying means G is driven by an alternating-current motor H. The motors F and H are connected by conductors to the generator C. When

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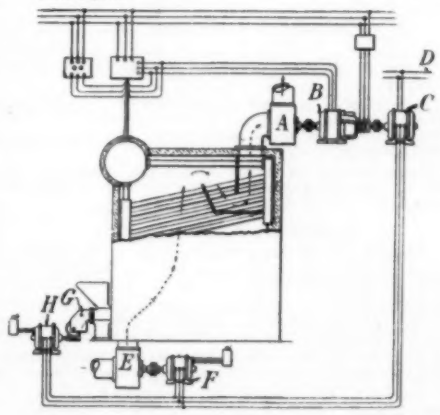
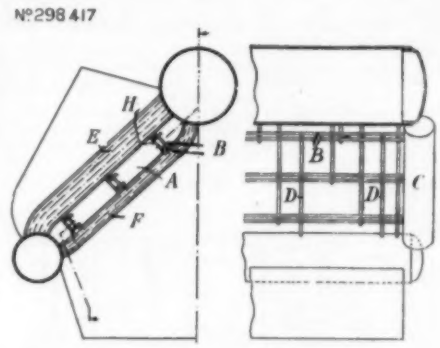


the system is operating and motor B is running at a certain speed, it will be seen that motors F and H are tied to motor B through the generator C, and hence operate at a speed proportional to the speed of motor B. If the speed of motor B increases, this increases the speed of the generator C, and hence also the speeds of the motors F and H, while if the speed of the motor B decreases, this decreases the speed of the generator C, and hence the speeds of motors F and H. Thus it will be seen that the forced draught fan or blower E and the fuel supplying means G are always driven at a speed which bears a certain relation to the speed of the induced draught fan or blower A. With this arrangement, therefore, it is only necessary to control the speed of the motor B in order to control the fuel and air supplying means for the furnace.—*October 11th*, 1928.

298,417. January 6th, 1928.—Improvements relating to Superheaters for Water-tube Boilers, Harold Edgar Yarrow, of Yarrow and Co., Ltd., Scotstoun, Glasgow.

This invention relates to water-tube boilers having superheaters in which the superheater tubes are horizontal or substantially horizontal. The generator tubes are spaced apart, and the intermediate space A accommodates the superheater tubes B, which are in the form of U tubes emerging from and returning to the superheater header C. To support these super-

N°298,417



heater tubes, which extend horizontally within the space A, some of the generator tubes are bent so as to pass across the space A immediately underneath one or more of the superheater tubes B. Some of the tubes D of the outer bank E are shown bent in this manner to pass under the outgoing and return limbs of some of the superheater tubes B, so as to support them. Others of the steam generating tubes belonging to the inner bank F are similarly bent, as shown, for example, at H, to support other rows of superheater tubes.—*October 11th*, 1928.

INTERNAL COMBUSTION ENGINES.

298,444. March 12th, 1928.—Improvements in the Construction of Internal Combustion Engine Cylinder Heads, James Sidney Drewry, of "Kingston," Willianway, Letchworth, Hertfordshire, and Shelvoke and Drewry, Ltd., of Icknield-way, Letchworth.

This specification describes a combustion chamber for internal combustion engines, in which the cylinder cover immediately

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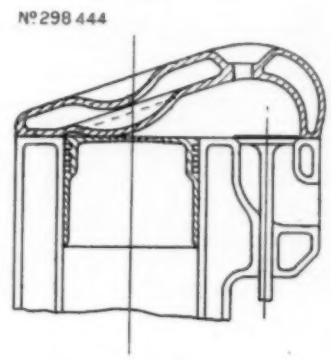


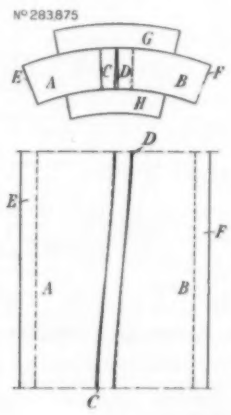
over the piston top is formed as an inverted spherical or ellipsoidal segment, as shown in the accompanying illustration. The object of the invention is to cause the propagation of the flame from the ignition point to be deflected from the dome in a constantly varying direction, thereby avoiding the formation of pockets of unignited gas.—*October 11th*, 1928.

DYNAMOS AND MOTORS.

283,875. January 14th, 1928.—Improvements in or relating to the Manufacture of Electrical Windings for Helical Winding Slots, *Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.*

In order to obtain certain electrical effects, the winding slots of electric machines were arranged obliquely. These winding slots are given a helical shape. When introducing or pushing in the portions of winding into the slots, they must follow the

N°283,875

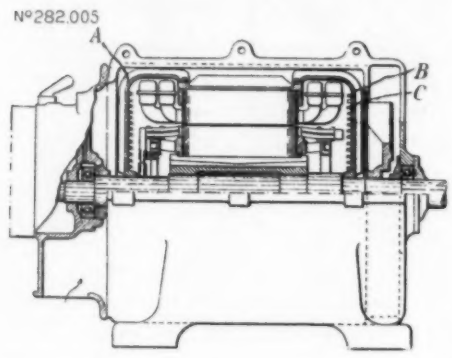


helical shape. As, however, they have been rendered rigid or stiff by baking, their insulation is damaged. The damage or injury can be somewhat reduced by making the cross section of the slot somewhat large, but damage or injury cannot be completely avoided thereby, and, moreover, winding space is lost or wasted, owing to which the output of the machine is reduced. These drawbacks are, it is claimed, eliminated accord-

ing to the present invention. At A and B are two tangentially acting press members They are formed from parts of a cylindrical tube, the wall thickness of which corresponds to the depth of the coil. The effective pressure surfaces C and D of these pressing members are fashioned to correspond to the helical shape, whilst the surfaces E and F directed outwards have flat bearing surfaces. The radially acting press members marked G and H are also parts of cylindrical tubes, the inner and outer diameters respectively of which correspond to the diameter of the winding. The press parts can be given the special shape in any desired manner. A particularly favourable process for the manufacture of the tangentially acting press parts is to use flat plates and to give them by twisting or bending the desired shape of the press parts. The outside surfaces E and F of these twisted plates, which are situated opposite the pressure surfaces, can then be made flat, for instance, by planing. In a similar manner, the radially acting press parts can be produced by bending flat plates to the shape of a cylinder and by planing flat their outside surfaces.—*October 4th*, 1928.

282,005. September 12th, 1927.—IMPROVEMENTS IN OR RELATING TO DYNAMO-ELECTRIC MACHINES, Wilhelm Robert Uggla, of Mörby, Stocksund, Sweden.

The invention relates to means for altering axially ventilated electrical machines that have a split outer casing. The machine is provided with inner end covers A and B, which complete the

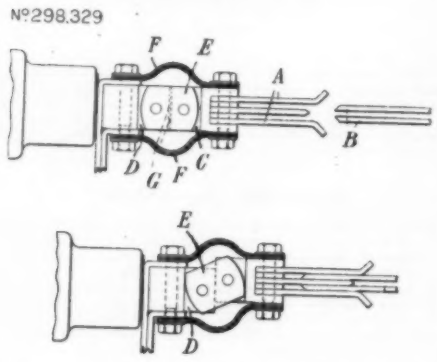


enclosure of the stator and rotor windings, and which are divided into two parts, in order that the alteration may be effected without removing the bearings of the shaft or bearing shields. In order to increase the cooling surfaces of the end covers the inner sides are provided with projections C. Similar projections or flanges may be provided on the outer sides of the end covers or only on these surfaces.—*October 11th*, 1928.

SWITCHGEAR.

298,329. August 25th, 1927.—IMPROVEMENTS RELATING TO CONTACTS FOR ELECTRICAL SWITCHGEAR OF THE TRUCK OR OTHER LIKE TYPES, George Ellison and Herbert Christopher Fox, both of Wellhead-lane Works, Perry Barr, Birmingham.

The object of this invention is to compensate defective alignment of fixed and movable switch contacts in a simple and satisfactory manner. The compensation for lack of alignment is preferably provided in the fixed contacts A, though, if desired, it may be provided in the movable contacts B, forming part of the slidable switchgear. The portions of the fixed and movable contacts which engage with each other are made from resilient copper plates which are arranged to overlap or interleave when brought together. The upper and lower plates in the group A have their free ends splayed outwardly to facilitate engagement, and the extremities of all the other plates are tapered or rounded for the same purpose. The contact plates A in the fixed group are mounted on a movable metal block C, which is attached to a



fixed metal block D by a pair of side links E, the latter being pivotally connected to both blocks. The two blocks are connected together by upper and lower laminated strips F, which are secured at their ends to the two blocks, and are preferably made to a bowed form. These strips not only afford a resilient connection between the two blocks, but also serve to carry current. The adjacent end faces G of the two blocks E D are arranged with only a small clearance between them, in order to limit the amount of angular movement that can be imparted to the movable block. If desired, a slight clearance may be provided at the pivots of the links in order to permit a small amount of torsional freedom in the contacts. If any small lack of alignment exists between the two contacts, the one set of contacts will accommodate itself automatically to the other, when the two are brought together, and risk of improper engagement or of injury to the contacts when the switch gear is pushed back into its normal working position is avoided in a simple and effective manner.—*October 11th*, 1928.

TELEGRAPHS AND TELEPHONES.

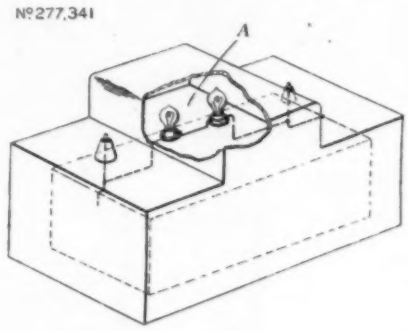
292,524. June 20th, 1928.—IMPROVEMENTS IN OR RELATING TO WIRELESS SIGNALLING, Telefunken Gesellschaft für drahtlose Telegraphie m.b.H., of 9, Tempelhofer Ufer, Berlin, Germany.

This invention relates more particularly to wireless signalling by means of short waves. It has been found in short wave signalling that the same signal is apt to be received several times in succession at short intervals. This multiple reception of the same signal is due partly to the fact that the signal transmitted proceeds round the earth in both directions, and partly to the fact that the signals may pass round the earth several times. The first-mentioned cause of such multiple reception disturbance can be eliminated by providing the receiving station aerials with reflectors, adapted to cut off radiation coming from a rearward direction. The object of this invention is to eliminate disturbances which may arise, due to the same signal reaching the receiving station several times from the same direction. Experiments have shown that the same signal may be heard two to three times or even oftener at the receiving station from the same direction, *i.e.*, at intervals of time which correspond to a complete passage round the earth. The interval of time corresponding to a single passage round the earth amounts to something rather less than one-seventh of a second. According to the invention, successive signals or groups of signals are transmitted at different frequencies which are changed at about one-seventh of a second intervals, and are received by means of a device which is rendered successively sensitive to the various frequencies in synchronism with the frequency changes at the transmitter.—*October 4th*, 1928.

MISCELLANEOUS.

277,341. September 6th, 1927.—IMPROVEMENTS IN ELECTRICAL CONDENSERS, *Dubilier Condenser Company* (1925), *Ltd., of Ducon Works, Victoria-road, North Acton, London, W.* 3.

In accordance with this invention, one or more lamps A are connected across the terminals of a condenser for the purpose



of relieving it of direct-current and residual charges, and for the absorption of surges. Lamps having carbon filaments may be employed because they give a lower resistance for high discharge currents or surges. Several alternative schemes are described.—*October 11th*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. "A Survey of Cadmium," by Mr. C. F. Moore. 7.30 p.m.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Queen's Hotel, Keighley. Ladies' night. "Romantic Britain," by Mr. J. Shuttleworth. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Engineers' Club, Albert-square, Manchester. "Electric Traction on Railways," by Mr. R. Brooks. 7.15 p.m.

PHYSICAL SOCIETY.—Imperial College of Science, Imperial Institute-road, South Kensington, S.W. 7. "The Physical Interpretation of Wave Mechanics," by Mr. G. Temple; "The Effect of Superimposed Magnetic Fields on Dielectric Losses and Electric Breakdown Strength," by Mr. Allan Monkhouse; "A New Alternating-current Potentiometer of Larsen Type," by Mr. Albert Campbell; "Ferromagnetic Ferric Oxide," by Professor E. F. Herroun and Professor E. Wilson. A demonstration of emulsions showing chromatic effects will be given by Mr. R. H. Humphry. 4.45 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—In the "Societies' Room," No. 24, Royal Technical College, George-street, Glasgow. Paper on "Hartmann Spiral Bricks," by Messrs. Tornblad and Mitchell. Film, Thompson Water-tube Boiler. 7 p.m. The Council will meet at 6.30 p.m. in Committee Room No. 26.

SATURDAY, NOVEMBER 24TH.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to the reconstruction works of Waterloo Bridge.

MONDAY, NOVEMBER 26TH.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. "Methods of Oil Extraction," by Mr. R. A. Bellwood. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN CENTRE.—Sopwith's Lounge, Northumberland-street, Newcastle-on-Tyne. Informal discussion, "Automatic Network Voltage Regulating Equipments." 7 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture. "Biology and Refrigeration: Lecture III.," by Dr. Franklin Kidd. 8 p.m.

TUESDAY, NOVEMBER 27TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Engineers' Club, Birmingham. "Electric Furnace Developments," by Mr. D. F. Campbell. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Watergate House, Adelphi, London, W.C. 2. London Graduates. "Petrol-electric Transmission," by Mr. S. Miall. 7.25 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN STUDENTS' SECTION.—Newcastle-on-Tyne. Annual dinner.

INSTITUTION OF ENGINEERING INSPECTION.—Hyde Park Hotel, London. Annual reception and dance. 8.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Diamonds," Lecture II., by Sir Wm. Bragg. 5.15 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "Fighting Corrosion," by Mr. T. Henry Turner. 7.30 p.m.

THE INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Engineers' Club, Waterloo-street, Birmingham. "Electric Furnace Developments," by Mr. D. F. Campbell. 7 p.m.

THE INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN CENTRE.—At the Central Station Hotel, Newcastle-on-Tyne. Annual dinner and reunion. 7 p.m.

WEDNESDAY, NOVEMBER 28TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Engineers' Club, Manchester. "The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles," by Dr. E. C. Wadlow. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Students' meeting. "Some Notes on Railway Engineering in Spain," by Mr. R. E. R. Hammond. 6.30 p.m.

THE INSTITUTION OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—At 36, George-street, Manchester. "Problems in Lift Service and their Solution," by Mr. J. Holliday. 6.45 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Port of London," by Mr. J. H. Estill. 8 p.m.

THURSDAY, NOVEMBER 29TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Hotel, Mill-street, Luton. Graduates' meeting. "Purchasing," by Mr. E. C. Thompson. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Hotel Metropole, Leeds. "Some Experiments in Measuring the Strain in the Reinforcing Bars of Concrete Steel Beams," by Mr. J. Gilchrist. 7.30 p.m.

THE INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON).—Denison House, 296, Vauxhall Bridge-road, Westminster, London, S.W. 1. "The Future Development of the Locomotive," illustrated by lantern slides, by Mr. D. S. Anderson. 6 p.m.

FRIDAY, NOVEMBER 30TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: SCOTTISH GRADUATES.—Regent Restaurant, 51, West Regent-street, Glasgow. "Brakes," by Mr. W. P. Kirkwood. 8 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—Grand Hotel, Birmingham. Annual dinner. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, S.W. 1. Thomas Lowe Gray Lecture. "The Possible Vibration of a Ship's Hull under the Action of an Unbalanced Engine," by Professor W. E. Dalby, F.R.S. 6 p.m.

INSTITUTION OF PRODUCTION ENGINEERS.—At the Society of Motor Manufacturers and Traders, 83, Pall Mall, S.W. 1. "Psychology as an Aid to Production," by Dr. G. H. Miles. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. "Frictional Resistance and Ship Resistance Similarity," by Dr. E. V. Telfer. 6 p.m.

THE JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. "The Manufacture of Decorative Metal Work," by Mr. C. W. Harvey. 7.30 p.m.

MONDAY, DECEMBER 3RD.

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.—Chemistry Theatre, Gower-street, London, W.C. 1. "Chemical Engineering Education and Research in Great Britain," by Dr. W. E. Gibbs. 5.15 p.m.

TUESDAY, DECEMBER 4TH.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow. "Gear Transmission," by Dr. H. E. Merritt. 7.30 p.m.

THE INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. "The Gezira Irrigation Scheme: Canalisation of the Gezira," by Mr. Harmood Victor Carruthers Johnstone; "Sluices and Machinery of the Gezira Irrigation Scheme; Blue Nile Dam and Canalisation," by Mr. James Robertson Russell. 6 p.m.

WEDNESDAY, DECEMBER 5TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Students' meeting. "The Renewal and Strengthening of Railway Bridges," by Mr. John Wishart Fairlie Gardner. 6.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London W.C. 2. "Fuel for Ships," by Sir Eustace Tennyson d'Eyncourt F.R.S. 8 p.m.

THE INSTITUTION OF AUTOMOBILE ENGINEERS: DERBY GRADUATES' BRANCH.—Joint meeting with the Derby Society of Engineers. Technical College, Derby. "The Heat Treatment and Mechanical Properties of Alloy Steels," illustrated by lantern slides, by Mr. J. H. Dickenson. 7.30 p.m.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. "Attenuation of Wireless Waves Over Towns (Effect of Towns, including Buildings, Tuned Aerials, &c., on Wave Damping)," by Mr. R. H. Barfield and Mr. G. H. Munro. 6 p.m.

FRIDAY, DECEMBER 7TH.

JUNIOR INSTITUTION OF ENGINEERS.—At the House of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Presidential address, by Lieut.-Col. J. T. C. Moore-Brabazon. 7.30 p.m.

THE INSTITUTION OF ENGINEERING INSPECTION.—At the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "The Application of Electro-deposited Metals to Engineering," illustrated by lantern slides and exhibits, by Mr. C. H. Faris. 5.30 p.m.

THE INSTITUTION OF WATER ENGINEERS.—Apartments of the Geological Society, Burlington House, W. (1) "The Consumption and Waste of Water, by Mr. John Bowman, M. Inst. C.E.; (2) "Legal Considerations relating to the Administration of Engineering Contracts," by Mr. E. J. Rimmer, A.M. Inst. C.E.; (3) "The Sandfields," by Mr. A. W. Burtt; (4) "The Corrosive Attack of Moorland Water on Concrete," by Messrs. W. T. Halcrow, M. Inst. C.E., G. B. Brook, F.I.C., M.I.M.M., and R. Preston. 10.30 a.m.

TUESDAY, DECEMBER 11TH.

INSTITUTE OF MARINE ENGINEERS.—85–88, The Minories, Tower-hill, London, E. 1. "Practical Refrigeration for Ships," by Mr. A. Greenfield. 6.30 p.m.

WEDNESDAY, DECEMBER 12TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Informal meeting. Subject for discussion, "Methods of Reducing Temperature in Deep Mining Work," by Mr. James Whitehouse. 6 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "Applications of Electricity to Medical Practice," by Mr. G. G. Blake. 8 p.m.

THURSDAY, DECEMBER 13TH.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Hotel Metropole, Leeds. "Notes on Power Station Construction," by Mr. A. H. D. Markwick. 7.30 p.m.